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Rotation of Crops in Paddy-Fields.

We have already written about this subject on several occasions, and are induced to return to the charge by what we have seen at Welimada, where owing to the scarcity of water the paddy-fields cannot in general be continuously cultivated. Here, instead of allowing them to lie fallow in grass, the villagers not uncommonly cultivate them in Kurakkan or sweet potatoes, following this with a crop of Kollu (*Dolichos biflorus*, L.), which, of course, will have the very desirable result of adding nitrogen to the soil when it is ploughed in.

With this example before us of actual rotation, it is to be hoped that more people in Ceylon will try its effects in their own paddy-fields. In Java, the moment the rice crop is reaped, the ground is softened with a little water and the rice straw, with or without manure, turned in, and a crop of vegetables is then at once planted on the land. It would seem likely that the food supply available in a village in Ceylon might be largely increased by the adoption of this method. Even the food supply for cattle might be greatly increased and improved by the cultivation of fodder crops upon the paddy-fields, a system which so far as we know has not yet been tried in Ceylon. There are many leguminous or nitrogen-absorbing plants which might probably be used for this purpose.

Many people, speaking with the confidence of ignorance, say that the native thoroughly understands the cultivation of rice, and that it is impossible to teach him anything. So he does, *up to his lights*, but that is no reason why other people should not have more powerful lights.

GUMS, RESINS, SAPS AND EXUDATIONS.

REVIEW.

BY E. ULE.

Kautschukgewinnung und Kautschukhandel in Bahia.

Notizblatt des Konigl. botanisches Gartens und Museums zu Berlin-Dahlem, Vol. V., No. 41a, 25th January, 1908, pp. 1-52.

Brazil still leads the way among rubber-producing countries. In the first place it still possesses vast forests of Hevea—the foremost among rubber plants for crop and quality. Considerable quantities are also obtained from *Hancornia speciosa, gom*, a member of the Apocynaceæ, as well as from the Euphoriaceau genus Manihot, growing in the North-East and in the interior.

Hitherto, attention has chiefly been paid to a single rubber-producing species of Manihot—*M. Glaziovii*, the Ceara rubber tree. *M. Violacea*, described a few years ago, is a herbaceous plant and yields but little caoutchouc.

Bearing all these different plants in mind, a considerable proportion of the rubber crop of Brazil remains unaccounted for. And this is to be attributed to the yield from the so-called Maniçoba species of Manihot. A general account of these by Dr. Ule appeared in the form of a translation in the last number of the *Tropical Agriculturist*. The paper now under review contains a still more elaborate account, with exact scientific descriptions and drawings and photographs of the different species included under the general term Maniçoba.

These are three in number and have been named by Dr. Ule *Manihot dichotoma, M. heptaphylla* and *M. piauhyensis* respectively. A map is given showing the distribution of these species in Eastern Brazil. From this we find that *M. dichotoma* occupies an apparently unimportant area in Bahia. *M. heptaphylla* occurs also in Bahia occupying a larger area further inland on the right bank of the Rio Sao Françisco, whilst *M. piauhyensis*, as its name implies, is found in the province of Piauhy.

Dr. Ule's paper is divided into the following chapters :—

- I. Introduction.
- II. Bahia and its Vegetation.
- III. The distribution of the various rubber plants.
- IV. Diagnosis of the new Manihot species.
- V. The harvesting and yield of rubber.
- VI. The country and its inhabitants.
- VII. Plantations of rubber.

Of these chapters I, II, III, IV, and VII are already very fully summarised in Ule's former paper. Additional matter of interest is afforded in chapters V. and VI.

In Chapter V. the following tables are given :—

	Rubber produced in Bahia.	Rubber from Bahia, together with that transported through the Province.		
	Tons.	Total.	Maniçoba.	Mangabeira.
1901 ...	50	—	—	—
1902 ...	140	—	—	—
1903 ...	344	828	496	355
1904 ...	892	1,274	939	416
1905 ...	1,142	1,681	1,444	261
1906 ...	1,157	1,756	1,410	263

II.—MANGABEIRA AND MANICOBA FROM THE WHOLE OF BRAZIL.

	Mangabeira.	Maniçoba.	Total.
1903 ...	662	1,722	2,383
1904 ...	855	2,226	3,081
1905 ...	637	2,682	3,319
1906 ...	653	2,664	3,317

The total output of rubber from South America for 1906 is estimated at 40,000 tons—more than half the world's total production.

With regard to the relative value of the three kinds, rubber from *Manihot heptaphylla* was valued at 2s. 9d. to 3s. per pound. *M. piauhyensis* at 4s. 1d., and *M. dichotoma* at 4s. 3d. to 4s. 6d., at a time when Para rubber stood at 4s. 9d. a pound.

Further points of importance in connection with the rubber industry relate to the country itself and its inhabitants. The population of the province of Bahia is estimated at two millions, by far the greatest number being negroes and Mulattos. But since the emancipation of the slaves in 1888 the difficulty of getting adequate labour has been considerable. Transport is rendered easy by various lines of railway and steamers which ply upon the Rio Sao Françisco. On the whole the author fortells a great future for these rubber trees in Brazil; and believes that they may be planted with advantage in other countries in comparatively dry and unproductive areas not suitable for Hevea.

JIQUIE MANICOBA RUBBER.

In an article which appeared in the last number but one of the *Agricultural News* (Vol. VI, p. 333), mention was made of a rubber-producing tree known as Jiquié Maniçoba, which occurs in great quantity in the Brazilian State of Bahia, but does not appear to be much known elsewhere. The rubber yielded by this tree, which is a species of Manihot, is stated to be of excellent quality, and fully equal to the best product of the Para region.

In the latest British *Consular Report* on the trade of Bahia, the accompanying interesting particulars are given with reference to this little known rubber tree :—

The Maniçoba of Bahia is a tree which attains to a height of 30 feet and upwards, with a diameter of 2 feet when fully matured in suitable soil. It belongs to the family *Euphorbiaceæ*. Its zone, so far as is at present known, extends from Maranhão to the southern borders of the State of Bahia, and it is found in greatest abundance in the regions adjoining the town of Jiquié, whence its local name.

The Jiquié Maniçoba is undoubtedly a new and distinct species of Manihot, and it must not be confounded with the Manihot of Ceara (*Manihot Glaziovii*). The seeds of the Jiquié Maniçoba are much larger than those of the Ceara.

The season for extracting the latex from the Jiquié Maniçoba extends from August to March. The latex possesses the valuable quality of coagulating spontaneously when exposed to the air, and it requires no acid nor other artificial coagulant of any kind. It has been found, from experiment, that this tree can be made to yield its latex between the fourth and fifth years from the time of first planting; but it yields its maximum returns from the age of eight years onwards.

The planters of Bahia have awakened to the fact that in the cultivation of Jiquié Maniçoba they possess a source of much potential wealth. Already several planters have begun to lay down plantations of the tree in question upon a large scale.

A planter established in the Jiquié district recently prepared a considerable quantity of rubber obtained from Maniçoba trees growing wild in the neighbourhood, and despatched it to New York. The consignment was classified in the New York market as being equal to the best Para rubber, and fetched $1·28 (5s.) per lb.—*Agricultural News*, Vol. VI., No. 146, November, 1907, p. 383.

FURTHER NOTES ON THE MANIÇOBA SPECIES OF MANIHOT.

Zimmermann, in "der Pflanzer," Aug. 1907, refers briefly to the three species described by Ule, seeds of all of which have now reached German East Africa.

Aug. Chevalier in the "Journal d'Agriculture Tropicale," Dec. 1907, describes under the *Manihot Teissonnieri* a tree growing in the Experimental Garden at Camayenne (French Guinea). In a note at the end of his description he remarks that the plant is possibly indentical with *M. piauhyensis* of Ule, of which only a preliminary account had then been published. From the description now available this seems actually to be the case.

R. H. L.

VARIATION AND SELECTION IN HEVEA.

(ABSTRACT BY R. H. LOCK.)

To the *Journal d' Agriculture Tropicale* for July, 1907, M. G. Vernet contributes a very interesting article entitled "A study of the Botanical and Physiological Variations of *Hevea brasiliensis* as applied to the question of Selection." He points out that Hevea is quite remarkably variable in all sorts of different characters. It is therefore excellently adapted to improvement by selection, and it should be possible to fix a number of different types greatly improved in yield and adapted to various situations, although this process will require a considerable number of years to carry out.

The author speaks first of variations in the botanical characters. These affect the leaves, flowers, fruits, seed—in fact, every organ which can be mentioned. The time of flowering varies considerably, and M. Vernet points out that the offspring of the trees which flower earliest are generally unsatisfactory and give a poor yield of latex.

Of particular interest are the observations recorded upon the variations in the amount of latex yielded by individual trees and in the proportion of caoutchouc contained in the latex. A table is given showing these variations in the case of six trees tapped on a particular day.

No. of tree.	Volume of latex obtained.	Proportion of Caoutchouc in the latex.	Dry rubber, per tree.
10	11 c. c.	39·74%	4,371 gr.
11	15	30·16	4,524
12	20	39·41	10,998
13	16	31·20	4,492
14	4	32·17	1,286
15	12	29·23	3,570
18	48	29·51	14,164

Thus, although the proportion of rubber contained in the latex varies considerably from tree to tree, nevertheless the volume of latex obtained will be a sufficient index of the relative value of a particular tree, if it remains moderately constant throughout the series of tappings.

The above table gives, however, very little idea of the absolute variation in yield. The author mentions two trees,

each nine years old and of practically the same circumference, one of which yielded four pounds of rubber during the same period as the other (tapped the same number of times) gave little more than a quarter of a pound.

Various objections have been urged against the selection of Hevea. These are successively answered by Mr. Vernet.

1. It has not been actually proved that selection will have any effect upon Hevea.

But there is no case recorded among either animals or plants in which selection when tried has not been effective.

2. The trees cannot be tested until eight years old, so that each step in the process will take eight years at least.

But each step will almost certainly mean a marked improvement.

3. Many people are satisfied with the yields already obtained from Hevea. But compare the case of Cinchona where the practice of selection in Java has killed out the industry in Ceylon.

4. Seed is so scarce that it is necessary to sow all that can be obtained. This objection is now, at any rate, out of date.

5. It is thought that cross-fertilization between different trees will nullify the effects of selection. This can be got over by the removal of inferior trees.

6. The great amount of labour entailed.

The present paper shows that a comparatively few tests of each tree will be sufficient,

7. The individual differences may diminish with the age of the trees.

Mr. Vernet's experience shows that this is not the case.

Various practical notes and suggestions are given with regard to methods of selection, after the separate tapping of individual trees has been carried out; the following classification is suggested:—

1. Trees giving a high yield; the seeds of these should be planted by themselves in order to afford the material for future selection.

2. Other trees giving a yield above the average; the seed of these should be selected for general planting.

3. Trees below the average. Their seeds should not be used.

4. The very worst trees should be cut down and replaced by selected seed.

Mr. Vernet concludes by remarking that only those who run their plantations on scientific lines can hope to retain a high scale of profits in the future.

RUBBER.

Some of the older plantations of Chiapas and Tabasco, Mexico, are quite extensive and have been producing rubber for a number of years. Visits to such plantations have afforded additional evidence of the practicability of securing considerable quantities of rubber from planted trees, but they also supply an additional reason for caution in enterprises based on the Central American rubber tree, for it is being found that the bark in the proximity of old cuts yields very little latex, so that the profits still remain uncertain. The rubber-forming materials of the latex are restored only slowly, if at all. The first cuts yield much more latex than in the Para rubber tree, but there is no such persistent production of latex nor any repeated flow to be obtained by paring back the edges of wounds which produce in the Para rubber tree more latex than the previously uninjured bark.

The effects of destroying the forest conditions and of exposing the soil to the sun and to the washing of the rains is shown in the backward condition of plantations on the Isthmus of Tehuantepec. Unless the soil is unusually fertile and well watered, the trees maintain a more rapid growth when they have the advantage of a surface mulch afforded by a partial or gradual clearing away of the forest.

The latex of Castilloa is also quite different from that of the Para rubber tree, and requires different methods of treatment. With slow coagulation the quality of the product deteriorates. Exposure of the latex to air and sunlight by spreading it out in thin layers produces better and more durable rubber than bulk coagulation, even with the thorough and repeated washings which are now generally advised.—*U. S. Department of Agriculture, Report for 1907 of Bureau of Plant Industry.*

THE PROPER DISTANCE FOR PLANTING HEVEA.

By M. O. Labroy.

The subject is here discussed at some length from various points of view, and the opinions of planters in Ceylon and the Federated Malay States are quoted, as well as those of Messrs. Wright and Carruthers. It is pointed out that Cacao is the only crop suitable for growing permanently in the same land as rubber; tea, coffee and camphor can only temporarily occupy the intervening ground.

In its natural habitat, trees of Hevea are seldom found closer together than 80 feet, and the reason seems to be that

it is necessary for a young tree to get its head well up above the surrounding vegetation; they do not therefore grow readily in company.

Planting at wide intervals of from 20 to 30 feet is coming into general use in the case of the more recent Malaya and Ceylon companies. Subsequent thinning can then be dispensed with and the trees can continue to develop unobstructed from 20 or 25 years. There result, under these conditions, trees of rapid growth with a short thick trunk well adapted for tapping, endowed with a high recuperative capacity, and resistant to fungus and insect diseases which are further discouraged by the absence of the dead stumps of felled trees.

On the whole the author sums up in favour of the system of wide planting.—*Journal d'Agriculture Tropicale, No. 78,* December, 1907.

THE NATIVE RUBBER TREES OF BRITISH GUIANA.

The trees so far known as capable of producing or likely to produce rubber, growing wild in British Guiana belong to the three genera—Sapium, Hevea and Forsteronia, the first two of which are included in the natural order Euphorbiaceæ, while Forsteronia belongs to the Apocynaceæ.

Numerous species of Ficus, known locally as Cumakaballi, occur in the forests, but the latex of none of them has so far been found to yield a sufficient amount of rubber to make the collection of it profitable.

Mimusops globosa, Gaertin, yields balata, a product which occupies a somewhat intermediate position between india-rubber and gutta-percha both in its composition and in its physical properties, and which fetches a price less than half of that usually obtained for the former.

SAPIUM.

The genus Sapium is widely distributed throughout the tropics of both the Old and New Worlds.

The majority of the species are found in South America, including the West Indies, but representatives occur in Tropical Asia, Australia, Malaya, China, Tropical Africa and Madagascar. With the exception of three or four species in South America, I can find no reference to this genus as containing trees capable of yielding India-rubber.

The members of the genus are large shrubs or trees sometimes reaching a considerable size, bearing simple, stalked leaves. A very distinctive character of the leaves, which is found in most of the species, is the presence of two small glands usually just below the point where the blade of the leaf joins the stalk.

The flowers are small and inconspicuous, and grow in long spikes which bear a few female flowers at the base, while the greater part of the spike is made up of male flowers. The male flowers have a membraneous calyx with two or three divisions, which encloses two or three stamens. The female flowers have a similar 3-lobed calyx which surrounds an ovary usually with two or three loculi, each containing one ovule.

The fruit is a dry capsule measuring not more than half an inch in diameter, showing distinctly usually three divisions, which splits open when ripe, disclosing one seed in each cavity.

The fresh seeds are surrounded by a thin pulp which is bright red in colour when the seeds are ripe in our native species. This pulp, which in botany is known as the aril, though quite tasteless, is much sought after by ants, which soon strip it from the seeds when they can get to them. I fancy also that this bright-coloured aril must serve as a source of attraction to birds, because young plants are frequently found springing up in places at long distances from any Sapium trees. The seed-coat beneath the pulp is dark in colour and very hard, so that the seeds if swallowed by a bird could probably pass through its alimentary canal without injury.

The seeds measure not more than a quarter inch in diameter, and on account of their small size are somewhat difficult to find when they fall on rough ground. In October, 1905, I was informed that the Indians on the Aruka River, in spite of their keen powers of observation, declared they had not seen the seeds, although they were accustomed to collect the rubber from the trees and also the young plants when they found that there was a ready sale to be obtained for them.

Observations seem to show that the trees flower from December to February and ripen seeds from March to May.

All of the specimens of Sapium which were collected and sent to Kew by the late Government Botanist, Mr. G. S. Jenman, have been referred to three species—*Sapium Jenmani,* Hemsl., *S. aucuparium,* Jacq., and *S. paucinervum,* Hemsl. Some of the earlier specimens

were referred to *S. biglandulosum*, Muell. Arg., but according to the compiler of the Index Kewensis, this species has been considered as identical with *S. aucuparium*, Jacq.*

Sapium Jenamni. Hemsl.

This species was named after Mr. Jenman, who first discovered it, and to whom we are indebted for most of our knowledge of this and of the other species of Sapium found in the Colony. It may be easily distinguished from the other two that I have mentioned by the leaves ending rather suddenly in a long blunt point, not a hooked gland, by the two glands at the junction of the leaf with the stalk being small and inconspicuous, and by the leaf bearing numerous minute transparent dots which do not show plainly in the fresh leaves, but are most easily seen by holding a dried leaf up against the light.

When the tree is in fruit, another distinguishing characteristic will be found in the fruit containing only one seed instead of the usual three, and by its splitting open into two halves when ripe.

The Carabisi Indians know this tree under the name Touchpong,† while the Arawacks call it Hya-hya.

Sapium Jenmani grows to a considerable size. Mr. Jenman speaks of it as "one of the largest trees in the forest," while Mr. J. E. Beckett in a report on an expedition undertaken to collect young plants of Sapium felled a tree, presumably of this species, which, three feet from the ground, had a circumference of 5 feet, while another specimen is mentioned which had a height of about 110 feet and a girth 3 feet from the ground of nine and a half feet.

The species is widely spread throughout the lower forest lands of the colony, but seems to be scarce in the immediate neighbourhood of the coast, the only specimen for which I am aware being one planted in the Botanic Gardens which is of very stunted growth.

Sapium Aucuparium, Jacq.

The character which in most cases serves to distinguish this species from the other two, occurring in British Guiana is the presence of a peculiar hooked gland at the apex of the leaf, which, however, is found in several other species growing outside the Colony.

The leaves show very considerable variety in size and shape both in those occurring in different parts of the same tree, at different ages of the plant and on different individuals. Thus the leaves on the lowermost branches of some of the trees are destitute of the hooked apex and end in a long blunt point as in *S. Jenmani.* Also the leaves of young plants and of saplings even measuring 15 to 20 feet high are invariably wanting in this characteristic feature.

The two glands at the base of the leaf are much larger and more prominent than in *S. Jenmani*, they are thick at the base and taper towards the blunt apex. The rest of the characters described for the genus Sapium apply in general to this species. The fruits are about half an inch in diameter and split open into three valves, disclosing the three seeds covered by the red pulp or aril. When the aril is removed the dark-coloured seed-coat underneath is found to be rough with small warts or tubercles.

S. aucuparium is a tree very widely distributed throughout the coast region where it often reaches a considerable height, though it never approaches the magnitude of *S. Jenmani.* There are many trees scattered about Georgetown and several occur in various parts of the Botanic Gardens where they have sprung up spontaneously, probably from seeds dropped by birds.

It is the "Gum-tree" of the creoles with which almost every boy is familiar, and the trees wherever accessible are tapped for bird-lime. The trees in the Botanic Gardens show abundant evidence of this tapping, which must have been going on from the time that they were mere saplings, for the bark from the base of the trunk to the topmost branches is everywhere scarred with cuts and slashes.

The method generally followed in collecting the 'gum' is to make a cut in the bark, and then the viscid and very sticky latex which issues from the cut is wound off on thin sticks or wires. These are then stuck horizontally into a

* In a copy of a paper I have just received through the kindness of the author, Mons. J. Huber, of the Para Museum, entitled "Revue Critique des Especes au genre Sapium," I observe that our specimens identified as *Sapium aucuparium*, Jacq. have been referred to a new species, *S. Hemsleyanum*, Huber. In order to avoid confusion, I prefer in this account to adhere to the former name by which several people in the colony have learnt to know the tree.

† Mr. Jenman adds the following interesting note with regard to the pronunciation of this word :—I have *very often* now heard the Indians pronounce the word, and I am myself satisfied that the first syllable is one of the innumerable cases in the Guiana languages of what is called an 'explosive.' That is to say, there is a T sound brought out uttered with a considerable and marked explosion, and this constitutes the whole syllable. The best way to write it is probably this—t'pong.

long stick placed upright in the ground so as to form attractive perches on which small birds may be likely to settle and are held fast by the sticky gum.

Away from the coast in the lower forest region *S. Aucuparium* does not seem to be nearly so plentiful or at any rate so widely distributed as *S. Jenmani.* During the three months spent by Mr. Beckett in the North-West District collecting Sapium seedlings and samples of rubber, he came across no trees which appeared to him to belong to this species, although he found plenty of *S. Jenmani.*

From the evidence, I am inclined to think that *S. Jenmani* is limited to the forests, while *S, aucuparium* is almost peculiar to the coast region.

Sapium Paucinervum, HEMSL.

This is another species first discovered by Mr. Jenman, in March, 1886, occurring on the Pomeroon River above Maccaseema. Unfortunately only fruiting specimens were found, and the description of the plant was based upon these. In March of the present year, Mr Ward, Agricultural Superintendent, brought back some specimens of a Sapium in fruit from the Camaria Road which were found to belong to the same species. Some leaves gathered by Mr. Beckett in the North-West District as well as some I obtained from some young saplings growing on the Hooboo Hills at the back of Mr. D. Young's grant also appear to be *S. paucinervum.* So that this species seems to be somewhat widely distributed through the forest region, but a more careful search is required to ascertain whether it is plentiful or not. The flowering stage is still unknown. *S. paucinervum* is easily distinguished from the two species already described by the characters of the leaves apart from the fruits.

It differs from both of them by the fewness of the lateral veins springing from the midribs, of which there are seldom more than ten pairs, except in the leaves from young plants.

The apex of the leaf ends in a long blunt point as in *S. Jenmani*, and is not hooked. The two glands at the base of the leaf are long and curved, and the basal part is narrowed into a stalk. Sometimes these glands, instead of being at the junction of the blade and the leaf-stalk are placed rather higher up, so that they spring from the base of the blade itself, and in the dried specimens appear to be situated on the under-side of the leaf. The fruits of *S. paucinervum* show three well-marked divisions as in *S. aucuparium*, but they are smaller, measuring when ripe $\frac{3}{8}$ inch across, and the three seeds in each fruit are also smaller and rounder not exceeding $\frac{3}{16}$ inch in diameter.

They are usually covered by a thin bright red pulp or aril except for one smooth, shiny, rounded spot on the outer side of each seed. When the aril is rubbed off, the black seed-coat beneath is slightly rough but not tuberculated or warted.

Mr. Jenman appends a note to the herbarium specimens of this plant, to the effect that it is associated by the Indians with the real Touchpong (*S. Jenmani*).

The following table shows clearly the characters I have described, and will prove of assistance in discriminating between the different species by means of the leaves or fruit alone, or both combined :—

	LEAVES.			FRUIT	SEED.
	Glands at base.	Principal lateral veins.	Apex of leaf.		
S. Aucuparium, Jacq.	Long and thick throughout.	More than 10 pairs.	Bent over to form a hooked gland.	Shows clearly 3 divisions nearly ½" diameter.	Outside covered with warts or tubercles, ¼" diameter.
S. Jenmani, Hemsl.	Small and wart-like.	Usually more than 10 pairs.	Long, straight and blunt.	Not divided into three, about ¾" diameter.	Outside finely warted, 3/16" diameter.
S. Paucinervum, Hemsl.	Long, curved and situated on a stalk.	Usually less than 10 pairs.	Do.	Shows clearly 3 divisions, about ⅜" diameter.	Outside only slightly rough, 3-16" diam.

In endeavouring to identify the different species of Sapium, leaves should always be obtained, if possible, from branches which bear fruit or flowers, or at any rate from branches as high up on the trees as one can reach. I have already pointed out that young saplings of *S. aucuparium* are wanting in the characteristic hooked gland at the apex of the leaf. Also the leaves of young plants of *S. paucinervum* or those found on sterile shoots usually possess more than ten pairs of lateral veins, although they show plainly the long, curved, stalked glands of this species.

RUBBER FROM SAPIUMS.

Unfortunately not much is at present definitely known about the most important thing in connection with the

Sapiums, i.e., their rubber-yielding capabilities. It may, however, be useful to bring together and to summarise as far as possible the facts that have been ascertained.

DISCOVERY OF THE RUBBER.

In an official report to the Government on some of the India-rubber and Gutta-percha trees of British Guiana, published in 1883 and reprinted in "Timehri" in the same year, Mr. Jenman describes his first acquaintance with Sapium rubber. His attention was attracted to it by information received from Mr. (now His Excellency) Sir Everard im Thurn, Governor of Fiji, who had seen in the coreal of some Carabisi Indians two or three small balls of india-rubber which were exceedingly elastic. Mr. Jenman sought out the collector and induced him to point out the trees whence it was obtained. I will quote Mr. Jenman's description.

"The trees were large individuals, four or five feet in diameter of trunk, and one hundred and twenty or more feet high. Their trunks were long, straight and unbranched for sixty or seventy feet from the ground. The lowest six feet of one had been scarred, and from the scars the milk had run and was dried in tears or strings several inches long on the bark. Most of the congealed rubber was, however, contained in the fissures made by the cutlass cuts, from which places it was rather hard to extract it because of the tenacity with which it held to the inner bark from which it had oozed. I gathered and made a ball, following the Indian plan of winding it up like twine, of what was on this trunk. They scar the trunk and then leave it, the milk oozes from the wounds, trickles down the bark and coagulates and becomes dry in a few days. My guide said it took three days to dry, but I should have supposed a shorter time might accomplish the change, the little rivulets are so very thin. That which was in the old cuts—cuts probably a year or more old—had turned black, but that in those recently made was nearly milk-white. The Indian boys, who are perhaps accustomed to play with the balls—as I noticed from several which they brought me they never make them large—stripped the dry strings very dexterously from the bark, taking good care to extract the larger portion to which I have alluded partly concealed in the incisions, and, stretching it with a good deal of tension, wound it up. These balls have wonderful elasticity and bounded with very little impulsion several feet off the ground. The rubber, too, seems exceedingly tenacious and strong. This method of collecting is that pursued in Ceara, the province of Brazil which produces *Manihot glaziovii.* It is very economical of time, for it saves the tedious operation of catching the milk in a vessel as it issues from the wound, which is the most bothersome of all the operations. The principal objection to it is that the rubber becomes soiled by the dirt adhering to the bark, a little of which it retains, and no doubt this would deteriorate its market value; but this cause of depreciation might be reduced to a minimum by carefully brushing the surface down prior to commencing collecting operations. Rubber which has foreign matter incorporated with it is classed under the term negrohead in the market, though its value depends on the measure of its freedom from dirt or other substance, having regard of course to the quality of the rubber itself when clean.

"I regard the discovery of this tree of great interest and probable importance, attaining as it does to such a vast size and producing a material of apparently excellent quality. The Indians know it under two names, the Carabisi calling it Touchpong, and the Arawacks, Cumakaballi.* Noble in proportions, spreading and lifting its massive head above its neighbours, it is one of the largest trees of the forest, and has a wide and general distribution over the deep belt of low country in the colony. Samples of both this and the Hatie† I have sent to England to be tested as to their probable commercial value."

Mr. Jenman refers to these samples in a report published in 1885, on "Balata and the Balata Industry, Forest Laws, etc."

"From a sample I sent home last year to be tested, Touchpong rubber was very favourably spoken of as to quality and estimated as worth from 2/3 to 2/6 per lb., which is the highest estimated value that has been given by experts for any of the substances, balata or india-rubber.

In his book on "Para Rubber," Mr, Herbert Wright gives the price of some samples of Plantation Para rubber in 1884 and 1885 as 2s. 8d. and 2s. 5d. respectively, with which the value estimated for Sapium rubber does not compare so unfavourably. Also on 1st January, 1885, Para Rubber of fine quality was selling at only 2s. 8d. per lb.

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* Cumakaballi, an Indian name for all the larger species of Ficus and not properly applied to the Touchpong.

† Hatie, an Indian name for species of Hevea growing in this colony.

Another interesting fact mentioned by Mr. Jenman is that Touchpong was one of the trees, the latex of which was employed by the collectors of balata for adulterating that product, the quoted price of which at the time in the English market was 1s. 3d. per lb., *i.e.*, half or less than half the value of the adulterant.

METHOD OF COLLECTION.

The Indians still employ the same method of collecting the rubber as that described by Mr. Jenman more than twenty years ago, which causes very considerable injury to the trees. By means of a cutlass two horizontal intersecting cuts are made, so that a large wedge-shaped piece is removed, including not only the bark but some of the wood beneath. From specimens of the bark of trees tapped in this way, obtained by Mr. Ward, I should say that it would be impossible for the tree to repair the damage done, and that a few of these cuts would be sufficient to completely ring and kill any but a very large tree. The danger of exterminating the Sapiums by this destructive mode of bleeding must be greater at the present day than formerly, because the ready sale found and the good price obtained for the rubber has within the last few years considerably increased the amount collected.

EXPORTS OF RUBBER.

Rubber first appears under a separate heading among the articles exported from the colony in the Blue Book for 1904-1905; the following are the quantities in pounds annually exported and their value for the last three years:—

	Quantity.	Value.
1904-1905	... 951 lbs. ...	$ 603 20c.
1905-1906	... 4,114 ,, ...	$2,575 40c.
1906-1907	... 2,563 ,, ...	$1,613 70c.
Total for three years.	... 7,628 lbs.	$4,792 30c.

(*To be concluded.*)

EDIBLE PRODUCTS.

CABBAGE GROWING FOR STOCK IN CUBA.

A late number of the *Boletin de la Secretaria de Agricultura* contains an article dealing with the growing of cabbages as a food for live stock in the island of Cuba, where this cultivation has been introduced fromthe United States.

The cabbage which has been acclimatized in Cuba is a well-known variety of English origin, known as the Dwarf Essex cabbage. It yields a large quantity of nutritious and succulent food, which is much appreciated by all kinds of live stock.

This cabbage is stated to flourish on all kinds of soil in Cuba, except on very moist clay soil. The seed is sown during the later months of the year, or in January, February or March of the following year, in furrows from 36 to 40 inches apart, this distance leaving ample space for the passage of tillage and weeding instruments between the rows of cabbages.

When the cabbage seed is drilled in rows, about 2½ lbs. are used per acre; when sown broadcast twice this quantity is required.

Growers in Cuba who raise this crop as a stock food cut, each morning, just the quantity required for the day's food of the live stock. If cut and not consumed till the following day, the cabbages become dry and unpalatable. The practice followed is to cut the cabbages about 4 inches above the ground; the stumps bud again and a second crop is obtained. The enormous amount of stock food yielded by this crop in Cuba will be understood when it is stated that a weight of nearly 150 tons per acre per annum was obtained on land which had only received a small amount of farmyard manure together with a light dressing of potassium chloride.

When fed to sheep and pigs, the cabbages can be simply placed in the open field, the animals being allowed to eat them at will. It is mentioned, however, that in feeding to cattle the best results are obtained by giving the cabbages in conjunction with other green food, or with corn. In connection with milking cows, it is well known that if fed in any quantity, cabbages impart an unpleasant flavour to the milk of these animals.

The writer of the article states his conviction that, with improved knowedge on the part of stock owners of the value of the crop in raising and fattening cattle and other kinds of live stock, cabbage culture will be largely extended in most countries where stock keeping is carried on, and the results which are reported from Cuba should certainly encourage stock owners to at least devote a small area to an experimental cultivation of the crop.—*Agricultural News*, Vol. VII., No. 150.

THE COCONUT WITH REFERENCE TO ITS PRODUCTS AND CULTIVATION IN THE PHILIPPINES.

Introduction.

The following pages are written chiefly in the interests of the planter, but the writer feels that the great agricultural importance which the coconut palm is bound to assume in these Islands is sufficient to justify the presentation of some of its history and botany.

For that part of the bulletin which touches upon the botany of the coconut I am indebted to Don Regino Garcia, associate botanist of the Forestry Bureau; for that relating to its product and local uses, to the courtesy of manufacturers in Laguna; and, for the rest, to personal experience and observations made in Laguna Province and in the southern Visayan Islands where, as elsewhere in this Archipelago, the coconut may properly be considered a spontaneous and not a cultivated product.

HISTORY.

The legendary history of the "Prince of Palms,"* as it has been called, dates back to a period when the Christian era was young, and its history is developing day by day in some new and striking manifestation of its utility or beauty. It seems not unreasonable to assume that much of the earlier traditionary history of the coconut may have been inspired as much by its inherent beauty as by its uses. Such traditional proverbs or folklore as I have gathered in the Visayas recognize the influence of the beautiful, in so far as the blessings of the trees only inure to the good; for instance, "He who is cruel to his beast or his family will only harvest barren husks from the reproving trees that witness the pusillanimous act;" and, again, "He who grinds the poor will only grind water instead of fat oil from the meat."

To this day the origin of the coconut is unknown. De Candol (Orgin of Cult. Plants, p. 574) recites twelve specific claims pointing to an Asiatic origin, and a single, but from a scientific standpoint

* The Prince of Palms," Treloar.

almost unanswerable, contention for an American derivation. None of the remaining nineteen species of the genus Cocos are known to exist elsewhere in the world than on the American continent. His review on the story results in the nature of a compromise, assigning to our own Islands and those to the south and west of us the distinction of having first given birth to the coconut, and that thence it was disseminated east and west by ocean currents.

BOTANY.

The coconut (*Cocos nucifera*, Linn.) is the sole oriental representative of a tropical genus comprising nineteen species, restricted, with this single exception, to the New World.

Its geographical distribution is closely confined to the two Tropics.*

Not less than nineteen varieties of *C. nucifera* are described by Miquel and Rumphius, and all are accepted by Filipino authors.

Whether all of these varieties are constant enough to deserve recognition need not be considered here. Many are characterized by the fruits being distinctly globular, others by fruits of a much prolonged oval form, still others by having the lower end of the fruit terminating in a triangular point.

In the Visayas there is a variety in which the fibrous outer husk of the nut is sweet and watery, instead of dry and astringent, and is chewed by the natives like sugar cane. Another variety occurs in Luzon, known as "Pamocol," the fruit of which seldom exceeds 20 cm. in diameter. There is also a dwarf variety of the palm, which rarely exceeds three meters in height, and is known to the Tagalogs as "Adiavan."

These different varieties are strongly marked, and maintain their characters when reproduced from seed.

USES.

The coconut furnishes two distinct commercial products—the dried meat of the nut, or copra, and the outer fibrous husk. These products are so dissimilar that they should be considered separately.

COPRA AND COCONUT OIL.

Until very recent years the demand for the "meat" of the coconut or its products was limited to the uses of soap boilers and confectioners. Probably there is no other plant in the vegetable kingdom which serves so many and so varied purposes in the domestic economy of the peoples in whose countries it grows. Within the past decade chemical science has produced from the coconut a series of food products whose manufacture has revolutionized industry and placed the business of the manufacturer and of the producer upon a plane of prosperity never before enjoyed.

There has also been a great advance in the processes by which the new oil derivatives are manufactured. The United States took the initiative with the first recorded commercial factories in 1895. In 1897 the Germans established factories in Mannheim, but it remained for the French people to bring the industry to its present perfection.

According to the latest reports of the American Consul at Marseilles, the conversion of coconut oil into dietetic compounds was undertaken in that city in 1900, by Messrs. Rocca. Tassy and de Roux, who in that year turned out an average of 25 tons per month. During the year just closed (1902) their average monthly output exceeded 6,000 tons, and, in addition to this, four or five other large factories were all working together to meet the world's demand for "vegetaline," "cocoaline," or other products with suggestive names, belonging to this infant industry.

These articles are sold at gross price of 18 to 20 cents per kilo to thrifty Hollandish and Danish merchants, who, at the added cost of a cent or two, repack them in tins branded "Dairy Butter," and, as such, ship them to all parts of the civilized world. It was necessary to disguise the earlier products by subjecting them to trituration with milk or cream; but so perfect is the present emulsion that the plain and unadulterated fats now find as ready a market as butter. These "butters" have so far found their readiest sale in the Tropics.

The significance of these great discoveries to the coconut planter cannot be overestimated, for to none of these purely vegetable fats do the prejudices attach that so long and seriously have handicapped those derived from animal margarin or margarin in combination with stearic acid, while the low fusion point of pure dairy butters necessarily prohibits their use in the Tropics, outside of points equipped with refrigerating plants. The field, therefore, is practically without competition, and the question will no longer be that of finding a market, but of procuring the millions of tons of copra or oil that this one industry will annually absorb in the immediate future.

* The coconut palm has been reared as far north as Indian River, Florida, latitude 28° N., but has not proven a profitable commercial venture.

Coconut oil was once used extensively in the manufacture of fine candles, and is still occasionally in demand for this purpose in the Philippines, in combination with the vegetable tallow of a species of *Stillingia*. It is largely consumed in lamps, made of a tumbler or drinking glass half filled with water, on top of which float a few spoonfuls of oil, into which the wick is plunged. In remote barrios it is still in general use as a street illuminant, and so perfect is its combustion that under a constant flicker it emits little or no smoke.

When freshly expressed, the oil is an exceptionally good cooking fat, and enters largely into the dietary of our own people. The medicinal uses of the oil are various, and in the past it has been strongly advocated for the cure of eczema, burns, as a vermifuge, and even as a substitute for cod-liver oil in phthisis. Its medicinal virtues are now generally discredited, except as a restorative agent in the loss of hair resulting from debilitating fevers. Its value in this direction may be surmised from the splendid heads of hair possessed by the Filipino women, who generally use the oil as a hair dressing.

Coconut oil is derived from the fleshy albumen or meat of the ripe fruit, either fresh or dried. The thoroughly dried meat is variously known as *copra, coprax*, and *copraz*. The exportation of copra is detrimental to the best interests of the planter, tending to enrich the manufacturer and impoverish the grower. The practice, however, is so firmly established that the writer can only record a probably futile protest against its continuance.

The causes which for a long time will favour the exportation of copra instead of oil in this Archipelago may be briefly stated as follows :—

(1) An oil-milling plant, constructed with due regard to economy of labour and the production of the best quality of oil, would involve an outlay of capital of $2,500, gold, and upward, according to capacity. The production of copra requires the labor of the planter's hands only.

(2) The oil packages must be well-made barrels, casks, or metallic receptacles. The initial cost of the packages is consequently great, their return from distant ports impracticable, and their sale value in the market of delivery is not sufficient to offset the capital locked up in an unproductive form. On the other hand, copra may be sold or shipped in boxes, bags, sacks, and bales, or it may even be stored in bulk in the ship's hold.

(3) When land transportation has to be considered, the lack of good roads still further impedes the oil maker. He cannot change the size and weight of his packages from day to day to meet the varying passability of the trail. On the other hand, packages of copra may be adjusted to meet all emergencies, and the planter can thus take advantage of the market conditions which may be denied to the oil maker.

(4) Perhaps the most serious difficulty the oil maker has to contend with is the continuous discouragement he encounters from the agent of foreign factories, who buys in the open market, and, bidding up to nearly the full oil value of the copra, finds an ample manufacturer's profit paid by the pressed cake, so valuable abroad, but, unfortunately, practically without sale or value here. The residue from the mill may be utilized both for food and for manure by the oil-maker who is a tree owner and who maintains cattle. For either of these purposes its value rates closely up to cotton seed cake, and the time is not remote when it will be recognized in the Philippines as far too valuable a product to be permitted to be removed from the farm excepting at a price which will permit of the purchase at less figure of an equivalent in manure. So active are the copra-buying agents in controlling this important branch of the industry, that they refuse to buy the press cake at any price, with the result that, in two instances known to the writer, thay have forced the closure of oil-milling plants and driven the oil-maker back to his copra.

Many copra-making plants in India and Ceylon are now supplied with decorticating, breaking, and evaporating machinery. The process employed in this Archipelago consists in first stripping the ripe fruit of the outer fibrous husk. This is effected by means of a stout, steel spear head, whose shaft or shank is embedded firmly in the soil to such a depth that the spear point projects above the ground rather less than waist high. The operator then holds the nut in his hands and strikes it upon the spear point, gives it a downward, rotary twist, and thus, with apparent ease, quickly removes the husk. An average operator will husk 1,000 nuts per day, and records have been made of a clean-up of as many as 3,000 per day. The work, however, is exceedingly hard, and involve great dexterity and wrist strength.

Another man now takes up the nut and with a bolo strikes it a smart blow in the middle, dividing into two almost equal parts. These parts are spread out

and exposed to the sun for a few hours, or such time as may be necessary to cause the fleshy albumen to contract and shrink away from the hard outer shell, so that the meat may be easily detached with the fingers.

Weather-permitting, the meat thus secured is sun dried for a day and then subjected to the heat of a slow fire for several hours. In some countries this drying is now effected by hot-air driers, and a very white and valuable product secured; but in the Philippines the universal practice is to spread out the copra upon what may be called a bamboo grill, over a smoky fire made of the shells and husks, just sufficient heat being maintained not to set fire to the bamboo. The halves, when dried, are broken by hand into still smaller irregular fragments, and subjected to one or two days of sun bath. By this time the moisture has been so thoroughly expelled that the copra is now ready to be sacked or baled and stored away for shipment or use.

All modern coconut-oil mills are supplied with a decorticator armed with revolving discs that tear or cut through the husk longitudinally, freeing the nut from its outer covering and leaving the latter in the best possible condition for the subsequent extraction of its fibre. This decorticator is fed from a hopper and is made of a size and capacity to husk from 550 to 1,000 nuts per hour.

Rasping and grinding machinery of many patterns and makes, for reducing the meat to a pulp, is used in India, Ceylon, and China, and, although far more expeditious, offers no improvements, so far as concerns the condition to which the meats are reduced over the methods followed in the Philippines. Here the fleshy halves of the meat are held by hand against a rapidly revolving, half-spherical knife blade which scrapes and shaves the flesh down to a fine degree of comminution. The resulting mass is then macerated in a little water and placed in bags and subjected to pressure, and the milky juice which flows therefrom is collected in receivers placed below. This is now drawn off into boilers and cooked until the clear oil is concentrated upon the surface. The oil is then skimmed off and is ready for market.

The process outlined above is very wasteful. The processes I have seen in operation are very inadequate, and I estimate that not less than 10 per cent. of the oil goes to loss in the press cake. This is a loss that does not occur in establishment equipped with the best hydraulic presses. It is true that very heavy pressure carries through much colouring matter not withdrawn by the primitive native mill, and that the oil is consequently darker, and sooner undergoes decomposition; but modern mills are now supplied with filtration plants through which this objection is practically overcome.

The principles of the above process are daily produced in thousands of Filipino homes, where the hand rasping of the nut, the expression of the milky juice through coarse cloth, its subsequent boiling down in an open pan, and the final skimming off of the oil are in common practice. Notwithstanding the cheapness of labour, it is only by employing a mill well equipped with decorticating, rasping, hydraulic crushing, and steam-boiling machinery, and with facilities to convert the residue to feeding or other uses, that one may hopefully enter the field of oil manufacture in these Islands in competition with copra buyers.

COIR.

The fibre of the coconut husk, or coir as it is commercially known, has never yet been utilized in this Archipelago, excepting occasionally for local consumption.

Second in value only to the copra, this product has been allowed to go to waste. The rejected husks are thrown together in immense heaps, which are finally burned and the ashes, exceedingly rich in potash and phosphoric acid, are left to blow away.

As the commercial value of the fibre is greater than the manurial value of the salts therein, it is economy to utilize the fibre and purchase potash and phosphoric acid when needed to enrich the soil.

Highly improved and inexpensive power machinery for the complete and easy extraction of the fibres of the husk, either wet or dry, is now rapidly superseding the tedious hand process once in such general use. Good patterns of machinery are shown in the "husk-crushing mill" (fig. 1), and in the "fibre extractor" (fig. 2).

The first breaks, crushes, and flattens out the husks by means of powerful, fluted metal rollers, and, in the second the broken husks are fed over a revolving drum set with teeth especially devised for tearing out the fibre from the entire mass. Finally, it is fed into one of the many forms of "willowing" machines, which reduces the mass to clean fibre, which is now ready for grading, baling, and ship-

ment. The residual dust and waste from this operation may be used as an sbsorbent for liquid manures, and ultimately returned to the plantation. The yield of fibre varies from 12 to 25 quintals of coir and 4 to 7 quintals of brush fibre per 10,000 average husks. In the Philippines the nuts yield a large amount of fibre and relatively small percentage of chaff and dust. With improved machinery and careful handling, 18 quintals of spinning coir and 5 quintals of bristle fibre from every 10,000 husks is a fair estimate of the product.

As the cost of manufacture is generally rated at one-half the selling price, and as we must add a further charge of 20 per cent. to cover freight and commission, we have resulting from the sale of the 23 quintals, or 2,300 kilos, at £16 per English ton, a balance of £11 11s. per hectare.

But there are other considerations which should not be overlooked. The husks of 10,000 coconuts will withdraw from the land 61·5 kilos of potash and 3 kilos of phosphoric acid, and the restoration of the full amount is called for to compensate for the growing wants of the tree, in addition to that withdrawn by the crop. The necessary fertilizers are worth, approximately, 5½d. per kilo, making a further reduction of £1 8s., and leaving as a net profit £10 3s. or, reduced to American money, nearly $50 gold per hectare.

The machines above referred to will cost $800, gold, and $1,200 additional will purchase and house the power necessary to operate them. Such a plant will work up 1,000 nuts a day, and handle in a year the output of a grove of 30 hectares. With the addition of two or more fibre extractors the capacity of the plant may be doubled without material expense, and it should rather more than pay its entire cost in one year.

Tuba.

Tuba is the fresh or mildly fermented sap drawn from the inflorescence of the coconut.

There are no figures or data of any kind available as a basis for an estimate as to the importance of this product, but its extent may be inferred from the fact that the outlying groves about Cebu, Iloilo, and the larger Visayan towns are practically devoted to the production of tuba, and not to the manufacture of copra.

Tuba is collected from the unexpanded blossoms as soon as they have fairly pushed through the subtending bracts. To prevent any lateral expansion, the flowers are tied with strips of the green leaf blade, and then, with a sharp knife, an inch or two of the extreme tip is removed. The whole flower cluster is now gently pulled forward until it arches downward. In a day or two the sap begins to drip and is then caught in a short joint of bamboo, properly secured for the purpose.

As a healthy tree develops at least one or more flowering racemes every month, and the flow of sap extends frequently over a period of two or more months, it is not uncommon to see a number of tubes in use upon one tree.

The workmen usually visit the tree twice daily to collect the liquor drawn during the preceding twelve hours in the larger tube, which he carries upon his back. He slices daily a thin shaving from the tip of the flower, in order that the wound may be kept open and bleeding. This process is kept up until nearly all of the flower cluster has been cut away, or until the sap ceases to flow.

More than a liter a day is sometimes drawn from one tree, and five hectoliters is considered a fair annual average from a good bearing tree.

In its fresh state tuba has a sweetish, slightly astringent taste; but, as the vessels in which it is collected are rarely cleansed, they become traps for many varieties of insects, etc., and it is, therefore, not a very acceptable beverage to a delicate stomach. When purified by a mild fermentation it is far more palatable.

A secondary fermentation of tuba results in vinegar, and on this account, chiefly, so much space has been devoted to this feature of the industry. The vinegar so produced is of good strength and colour, of the highest keeping qualities, and of unrivalled flavour. Its excellence is so pronounced that upon its inherent merits it would readily find sale in the world's markets, and although the local demand for the tuba now exceeds the production, its conversion into vinegar will probably prove the more profitable industry in the future.

Spirits are distilled and in some places sugar is still made from the flower sap; and, while the importance of these great staples may not be overlooked, their commercial value as products of this tree are relatively insignificant.

Minor Uses.

In addition to eighty-three utilities described by Mr. Pereira,* it is in very common use in the Philippines for:

* Quoted in "Watt's Dictionary, II, 456.

1. Coconut Cream.—The freshly-ground fruit, reduced to a pulp and strained, is consumed in that form or made into cakes with rice. It makes a delicious and nutritious food. According to Dr. W. J. Gies, in experiments lately published* its nutritive value is due to 35·4 per cent. of oil, about 10 per cent of carbohydrates, and 3 per cent. of protein. The amount of cellulose (fibrous matter) is only 3 per cent., and its digestibility is easy when the mass, by grating, is reduced to a fine degree of comminution.

2. The "milk" or water is used sparingly as a beverage. It is also fermented and converted into inferior vinegar.

3. The hard shell is used as fuel. When calcined, it produces a black, lustrous substance, used for dyeing leather.

4. The same shell, aside from many uses quoted by Pereira, is used here for every conceivable form of cup, ladle, scoop, and spoon.

5. From the tough midrib of the leaf, strong and beautiful baskets of many designs are made, also excellent and durable brooms, and from the part where the midrib coalesces with the petiole pot-cleaning brushes are made.

6. The roots are sometimes used for chewing, as a substitute for Areca. They also furnish red dyestuff, and with one end finely subdivided may be used in making tooth brushes.

7. The leaves and midribs, when burned, furnish an ash so rich in potash that it may be used alone in water as a substitute for soap or when a powerful detergent is required.

8. The fibre of the husk is used extensively by the natives for calking boats.

9. The milk is used in the preparation of a native dish of rice, known as "casi." It is an excellent and highly prized dietary article, prepared with rice or in combination with chicken or locusts.

10. The oil, melted with resins, is an effective and lasting covering for anything desired to be protected from the ravages of white ants.

11. The timber is used to bridge streams and bog holes, and the slowly decaying leaves to fill them up and render them temporarily passable.

12. The fibre is used in cordage and rope making, but to a far less extent here than in India.

* . Torr. Bot Club, 1902.

Its further uses are, in general, those current in the Orient. Briefly summed up, its timber is employed in every form of house construction; its foliage in making mats, sacks, and thatches; its fruit in curry and sweetmeats; its oil for medicine, cookery, and illumination; its various juices in the manufacture of wines, spirits, sugar, and vinegar; while not to overlook a final and not inconsiderable Filipino product, the splinters of the midrib are used in making toothpicks.—*Department of the Interior. Philippine Bureau of Agriculture, Farmers' Bulletin*, No. 8.

ROSELLE: ITS CULTURE AND USES.

By P. J. Wester.

INTRODUCTION.

Fruits and economic plants indigenous to the Tropics are now as never before attracting the attention of the people of the United States. Some, such as the avocado and the guava, are natives of the Western Hemisphere; others, like the roselle, are introductions from the Old World.

A strictly tropical plant, the roselle is very sensitive to frosts. This, together with its peculiar habit of blooming late in October regardless of the time when the seed is planted, has restricted the cultivation of the roselle to tropical and subtropical regions. Its distribution, for this reason, has not been so general nor has the plant become so widely known as introduced plants indigenous to the Temperate Zone. It is, however, only rational to assume that this objectional feature could be overcome were persistent efforts made with that end in view, and that the roselle, like so many other cultivated plants which have yielded to changed climatic conditions, would adapt itself to the shorter summers of a higher latitude.

Introduced several years ago into California and Florida, the roselle deserves a wider cultivation than it now enjoys, and should prove a valuable acquisition to the tropical islands of the United States and to the Canal Zone. The cultivation of the roselle is so simple and its requirements so few, that in the Tropics and Subtropics it should be an indispensable plant in the garden of every family. This fact, in view of its peculiar adaptability for jelly making, should cause the roselle to become a plant of considerable importance in the United States at no distant date. The roselle is probably the only plant in cultivation in which the part utilized

for food* is the calyx. Of rather low nutritive value, thickened calyx possesses excellent qualities for the manufacture of jelly and alied products. Preparations made from it closely resemble in colour and flavour those made from the cranberry. It is rather singular that its season of maturity also coincides with that of the cranberry.

In Queensland, where the culture of the Roselle has in recent years assumed considerable proportions, the fruit is utilized largely in the manufacture of jam. In the United States its principle use would probably be as a substitute for cranberries in the household and in the manufacture of jelly.

HISTORY AND GEOGRAPHICAL DISTRIBUTION OF THE ROSELLE.

The almost total absence of literature relative to the roselle until the last two decades and the lack of culture varieties would seem to indicate that the culture of this plant is of comparatively recent origin. De Candolle, in his "Origin of Cultivated Plants," 1885, does not mention it.

The writer has examined many of the older works on Indian Agriculture without finding more than one referring to the roselle. This work† is devoted to fibre-producing plants, which shows that roselle was early cultivated for its fibre. The author says, speaking of roselle, okra, and *Hibiscus abelmoschus*: "The dietical use of these species has been mentioned in order to show that if cultivated on account of their fibre they would also be useful for other purposes"; and it would seem from this quotation that the various uses of the roselle were not generally known at that time. For more than thirty-five years subsequent writers on Indian Agriculture maintain absolute silence on the subject, and Duthie‡ mentions the plant only incidentally. Woodrow§ speaks of its utility for jelly making. In India the plant has been grown chiefly for its fibre. It has apparently not attained much importance for culinary purposes.

The writer has been unable to obtain any data relative to the introduction of the roselle into the British Colonies in Australia, where its cultivation evidently is more extensive than anywhere else in the world, as, according to Semler,* two large preserving factories utilizing the roselle were in operation in Queensland in 1892. Shinn† refers to roselle jam as being shipped to Europe in large quantities.

The Queensland Agricultural Journal, volume 6, page 371, published in 1900, contains the longest treatise on the roselle that has come to the attention of the writer. Its brevity, it being less than five pages in length and containing no reference to any previous literature, presupposes the recent development of the industry there. In Queensland the calyces are mainly utilized in the manufacture of jam, but are also, according to the article cited, well adapted for pickles, while the writer also calls attention to the fact that the roselle can be propagated from cuttings, and that such plants bear fruit when earlier and more vigorous seedlings bear little or none. The seed is sown in October in Queensland.

The roselle is hardly mentioned in the horticultural literature of the West Indies, indicating that it is an object of indifference there. It was probably introduced from India before 1855, as Royle‡ in a work published that year says that it is there called "red sorrel."

In Hawaii the roselle, although introduced long ago, has not received much attention.

Eleven or twelve years ago a Mr. Naustadt, of San Francisco, imported seed from Queensland, and the plant was tested and seed subsequently distributed in California by the Agricultural Experimental Station of that State. The plant received much favourable comment there from those who tested it at that time.§ Later literature is silent on the subject.

The name in florida, "Jamaica sorrel," is evidently an indication that the plant was introduced from Jamaica—at what date the writer has been unable to ascertain—but it was probably not extensively grown in Florida before 1887, as P. W. Reasoner¶ does not refer to it. Harcourt|| does not speak of it.

In Florida, as in California, those who have tried the roselle have nothing but praise for the plant, and considerable interest in it is manifest, but its culture

* For analyses showing the food value of the calyx and pod of the roselle see Farmers' Bulletin, 293, page 14.

† Royle, J. F.—Fibrous Plants of India, 1855, p. 260.

‡ Duthie, J. F.—Field and Garden Crops of North-Western Provinces and Oudh, 1893.

§ Woodrow, M.—Gardening in India, 1899, p. 183,

*Semler, H.—Tropische Agriculture, 1892, p. 391.

† Report of the California Agricultural Experiment Station, 1896-97, p. 382.

‡ Royle, J. F.—Fibrous Plants of India, 1855, p. 260.

§ Report of the California Agricultural Experiment Station, 1897-98 p. 236.

¶ Bull. 1, Division of Pomology U. S. Dept. of Agriculture, 1887.

|| Harcourt H.—Florida Fruits, 1896.

on a large scale has not yet, to the knowledge of the writer, been undertaken by anyone.

The assumption by Royle* that the name roselle is a corruption of the French word "oseille" (the equivalent of the English "sorrel") seems very probable. In the ivolutionary stages the name has at different times been spelled "rouselle," "rozella," and "rosella."

BOTANICAL CHARACTERS AND RELATIONSHIPS.

Roselle (*Hibiscus sabdariffa*, L.), or Jamaica sorrel, as it is sometimes called, is an annual from the Tropics from the Old World belonging to the large family Malvaceae. Itself furnishing the roselle fibre of commerce, it is closely related to several genera containing fibre producing plants: Sida, Malva, Althea, and Lavatera. Its most important relative is cotton (*Gossypium*, sp.). Of vegetables, okra (*Hibiscus esculentus*, L.) is related to the roselle. Among related ornamental plants may be mentioned species of Abutilon, Hibiscus, Althea, and Malva.

The habit of the roselle is similar to that of the cotton plant; the stem is reddish, branching profusely. As usually planted—that is, in February and March—the roselle attains a height of from 5 to 7 feet. The leaves on the young plants are entire; as the plant increases in size the leaves change to palmately five parted; later, the leaves in whose axils the flowers are borne are three parted. The large almost sessile yellow flowers, each with a red eye, are usually borne singly in the axils of the leaves. They fade before the day is past and the subsequent enlargement of the calyces is then very rapid. In less than three weeks they attain their full size and are ready for picking. If the "fruit," if we may so call it, is not now picked and the seed is allowed to mature, the plant dies early in January. There are in the axils of the leaves several latent flower buds, and when the calyces are picked as soon as they are full grown these buds develop and the productivity of the plant is greatly increased.

VARIETIES.

The roselle being a plant of recent cultivation, and one that only to a slight extent has been exploited for commercial profit except as a fibre plant, it having been grown mostly as a curiosity in the gardens of interested individuals without any thought of improving the plant, it is only natural that no cultural varieties have developed.* Without any thought of improving the roselle, the writer during the summer of 1904 obtained a few plants in Coconut Grove, Fla., from Mr. W. A. H. Hobbs, and planted them in the Subtropical Garden, Miami, Fla., in order to have the plant under observation.

As the plants bloomed and fruited the marked variations in the fruits on the different plants suggested that there was an excellent opportunity to breed a new and distinct strain of the roselle, and at the suggestion of Prof. P. H. Rolfs, at that time Pathologist in charge of the Subtropical Laboratory and Garden, seed was saved from the best plants. With this seed for stock the writer began systematized breeding the next year. A number of the plants fruiting in the autumn of 1906 had calyces of such large size and exhibited such distinct characters that they were thought worthy of naming as a variety, and the name "Victor" has therefore been given to this sort.

When it is remembered that these are from plants in the second generation, the improvement is remarkable. As it was thought that these plants might be a special strain, inquiries were made to find out whether the original plants had any previous history, but this inquiry only served to confirm the fact that they were of the ordinary variety grown in Florida. Mr. William A. Taylor, of the Bureau of Plant Industry, suggested to the writer that this capacity for improvement might be due to the fact that the roselle has previously been principally grown for fibre, which doubtless is correct. Another attempt to breed the roselle was made by Dr. H. J. Webber in the nineties at Eustis, Fla., where the Subtropical Laboratory was then located. This work was, unfortunately, terminated by the severe freeze of 1895.

The plants of the Victor variety are inclined to be a trifle more dwarf than the common kind, but the foliage is similar. The measurements of the calyx of the common variety are, length 33 mm., diameter 22 mm.; in the improved type the measurements are 49 mm. and 28 mm., respectively. The increase in size is thus seen to be rather more in length than in diameter. Calyces of the improved type have, in some instances, been 60 mm. long and 38 mm. in diameter. The improved type is also distinct in being more strongly ribbed

* Royle, J. F. Fibrous Plants of India, 1855, p. 260.

* Since this article was written, O. W. Barrett, of the Bureau of Plant Industry, has informed the writer that he has heard of a variety with straw-colored calyced. This report, however, has not been verified.

longitudinally and in having the calyx not so closely appressed to the seed pod as in the common variety. It is frequently inclined to be convolute at the apex.

CULTIVATION AND FERTILIZATION.

The roselle will thrive on any soil that is moderately rich or that is supplied with the necessary plant food in the form of commercial fertilizer. Stable manure should be used sparingly only and should be supplemented by phosphates and fertilizers containing potash, as an excess of ammonia in the soil tends to the development of large plants at the expense of their productiveness. This is particularly true on low-lying land where moisture is abundant, and the high pine lands in Florida are for this reason preferable to the muck and prairie lands. Land that is subjected to inundations and soil sufficiently drained should be avoided The plant has been found well adapted to the clayey soil of California. Henricksen* says that a sandy loam is preferable to other soils.

The roots of the roselle descend to greater depths than those of many other crops, and the land should be plowed deep, and, when the soil is clayey, well pulverized. This plant is very much subject to root-knot nematodes (*Heterodera radicicola*), and should not be planted on land infested with this pest, as that would only result in almost absolute failure. The roselle always comes to the market at the same time of the year, and, as no literature on the subject that had come to the attention of the writer mentioned any attempt to grow it successively, several sowings were made in 1906 at the Subtropical Laboratory at different times of the year, to note the influence on the habits of growth, the season of maturity, and, possibly, the size of calyx. These plantings were made as follows:—No 559, April 1; No. 560, May 1; No. 561, June 1; No. 562, June 23.

Besides these, seeds from large selected pods were sown June 26 (No. 542). Plant No. 542 came into bloom October 26, a few days in advance of Nos. 560, 561, and 562. A few days later bloom was noted on No. 559. Notes made in 1905 show that plants from seed sown on June 10 bloomed October 25. The plants from the earlier sowings naturally developed into large plants, with greater bearing capacity. This advantage was offset, however, by the fruits being to a marked degree smaller than those from later sowings. A comparison of the different plants in this experiment indicates that to combine high yield with the production of large pods the seed should be planted about May 15 in South Florida.

Make the seed bed in a place sheltered from high winds and work in thoroughly a moderate quantity of stable manure or commercial fertilizer. Sow the seed thinly in drills 6 inches apart, covering the seed from ¼ to ½ inch, then firm the soil, and, if dry, water thoroughly. The seed will germinate in a few days. If the weather is dry, the young plants should be watered as occasion requires. When the plants are 3 to 4 inches high they are ready for transplanting to the field.

The plants should be set out in rows 6 to 10 feet apart and 4 to 8 feet apart in the row, according to the fertility of the land and the supply of moisture. The seedlings are easily transplanted if proper precautions are taken. The work should preferably be performed on a cloudy day or late in the afternoon. Where a few plants are desired for home use only it will be found advantageous to sow a few seeds where the plants are to remain permanently and when the plants are well developed to thin out to one plant to a hill.

Experiments with different fertilizers have been started at the Subtropical Laboratory, but have not been carried on for a sufficiently long time to indicate the best form in which the fertilizer should be applied. Meantime, a formula of nitrogen, 4 per cent; potash, 7 per cent., and phosphoric acid, 6 per cent., has given good results. One-third of the actual ammonia is derived from nitrate of soda and the other two-thirds from dried blood. The sources of potash and phosphoric acid are muriate of potash and acid phosphate, respectively.

The fertilizer should be applied at the rate of from 1,000 to 2,000 pounds to the acre, according to the fertility of the land. On lands rich in ammonia the nitrogenous elements should be greatly reduced. It should be understood that this applies to Florida soils and conditions. The amount, and possibly the formula, would probably have to be modified in other sections. In the sandy and leachy soils of Florida it will be found advantageous to make several small applications instead of applying the total quantity at the time of planting. No cultivation is necessary, except to stir in the fertilizer and to keep down the weeds while the plants are small. When the ground is well shaded by the plant cultivation may be discontinued.

* Bull. 171, Office of Experiment Stations, p. 38

YIELD.

During 1906 experiments were well under way to ascertain the total yield of the roselle plant, but a hurricane in October inflicted so much damage on the plants in the experimental area that accurate data were unobtainable. Henricksen* quotes the yield as four pounds of fruit to each plant, averaging two pounds of calyces, the useful part, and adds, "Plants observed at Pueblo Viejo in sandy loam were estimated to yield double that amount."

HARVESTING AND MARKETING THE CALYCES.

In less than three weeks from the time of flowering, the calyces are ready for picking. In South Florida the first fruit is gathered about the middle of November.

It has been already pointed out how the yield may be largely increased by picking—going over the field every few days to pick the full-grown calyces, which will force the plant to send out new flower buds. By these repeated picking the plants are forced to fruit continuously until late in February, whereas otherwise they would cease to bear in December. Moreover, the calyces are more brittle and more easily broken from the plants while young and tender, and in the manufacture of jelly make a lighter red and a more transparent product than those from the more mature fruit. On poor land it would be of advantage to make a small application of fertilizer to the plants in December.

The fruit is seen at present in local markets only and is sold by the quart. Its excellent quality for making a sauce so closely imitating in flavour the cranberry as to deceive the very elect are not well known by the public, or it would be a formidable rival in the south to that fruit, on which transportation charges are necessarily high owing to the great distance it must be transported. The crisp and juicy appearance of the roselle is diminished by being too long in the hands of the dealer, but this does not indicate deterioration of its useful qualities.

COMPOSITION AND USES OF THE FRUIT.

In the roselle it is the large, reddish, fleshly calyces surrounding the seed pod that are used for food. As already stated, a considerable industry has lately been developed in Queensland, where the fruit is made into jam and exported. There is no reason why a similar industry should not grow up in the United States. The usefulness of the roselle as a substitute for cranberry sauce has been emphasized already, and its qualities for making jelly are unexcelled. In the United States it would probably become of greatest importance in the manufacture of jelly.

* Bul. 171, Office of Experiment Stations, p. 38.

An analysis of the calyx was made by the food laboratory of the Bureau of the Chemistry, which at the same time made an analysis of the cranberry for comparison, the uses of the two fruits being so similar. It will be seen from these analyses (see table below) that the constituents of the two fruits occur in nearly the same proportions, practically the only difference being that traces of benzoic acid in some form are present in the cranberry, while absent from the roselle.

COMPARATIVE ANALYSES OF THE COMPOSITION OF THE ROSELLE AND THE CRANBERRY.*

	Roselle. Per cent.	Cranberry. Per cent.
Wa	88·91	88·53
Solids	11·09	11·47
Ash	·89	·25
Marc (insoluble matter)	6·67	4·60
Acid (as malic) ...	2·77	2·74
Reducing sugar as invert	·33	1·90
Sucrose	·03	·10
Benzoic acid	Absent	Present
Starch	"	

In preparing for cooking, take the pod between the thumb and forefinger of the left hand, stem end up; cut off the stem and the basal end of the calyx to where the seed pod is united with the calyx, when a slight pressure with the fingers holding the pod will force out the seed pod. After preparing in this way, the calyx may be used for making sauce, jam, and transparent, bright red jelly. Many other dishes will suggest themselves to the thrifty housewife. The calyces may also be separated from the seed pods and dried in the sun or in an evaporator, and are in this form, according to Mr. O. F. Cook,† occasionally seen in the markets of the tropics. The juice of the calyces could probably be boiled to a syrup and used as a flavouring extract at soda fountains, and the fruit might also be used in colouring jellies, jams, or similar products as a substitute

* Weight of fruit of roselle, 6·11 grams; cranberry, 0 94 gram. Percentage of edible portion: Roselle, consisting of calyx minus the portion of its base which is cut away in removing the seed pods, 50 22; cranberry, 100.

† Contributions from United States National Herbarium, Vol. VIII, pt. 2, p. 160.

for coal-tar dyes where a bright red colour is desired.*

USES OF THE PLANT FOR FIBRE.

While this paper has been prepared primarily with reference to the utilization of the fruit of the roselle, the plant is, as previously stated, grown in India for its fibre, which is used in the manufacture of cordage and coarser textile products. Considered from this standpoint, the plant without further breeding could be cultivated over a large area in the Southern States, as the crop would be harvested before it was damaged by early frosts. On account of the vigour of the plant and its easy cultivation it is well worth a trial with this end in view. "For this purpose the crop is cut while in flower, dried, made into bundles and soaked in water for fifteen or twenty days. It is then possible to wash out a strong silky fibre known in commerce as roselle hemp, considered by some to be the equal of jute. The leaves are sometimes used as a salad and the seeds are supposed to have medicinal properties. They are also fed to cattle and poultry." †

BREEDING.

The roselle is an annual, and consequently seed must be saved every autumn for planting the next spring. To improve the strain the grower should go over his field repeatedly when the fruit is setting and tag such plants as combine great vigour with large bearing capacity and have calyces large and well formed. To obtain the best results in a comparatively short time it would be expedient to bag and hand-pollinat the flowers. When the seed pods turn yellow they should be gathered from time to time and dried, after which they are easily thrashed out. Keep the seed in a dry place secure from moths and rats.

During a long period of cultivation nearly all of our vegetables have become so domesticated that they may be forced to grow and produce at will where frostless conditions prevail; hence we have fresh tomatoes, egg-plants, etc., in wind winter in the South. The roselle not having had this advantage, can at present be cultivated only where frost is unknown or nearly so, as its growing period is very long and its blooming and fruiting season extends late in the year.

* After this bulletin was prepared the writer was informed by Mr. W. W. Tracy, sr., of the Bureau of Plant Industry, that he, together with Mr. Coulter, made jelly from the small and tender branches several years ago. He adds, that the leaves were picked off before boiling the stems.

† Contributions from the United States National Herbarium, Vol. VIII. Pt. II., p. 159.

Should it, however, be found desirable to grow the plant in temperate climates, there is no reason to doubt that the roselle would adapt itself to shorter summers. Its near relative, Sea Island cotton, is a striking illustration of how a plant may adapt itself to entirely new conditions, and the following quotations from Dr. H. J. Webber are, in this instance, of timely interest :—

According to tradition and the reports of growers, Sea Island cotton when first introduced into this country from the West Indies was a perennial unsuited to the duration of the seasons of the latitudes of the Sea Islands off South Carolina and Georgia, where is seldom matured fruit. However, through the selection of seed from early maturing individual plants and through better methods of culture, there has developed an improved race which now seems to be thoroughly adapted to the conditions of growth in the regions referred to. Furthermore, under the continuous and rigorous selection to which the plants have been subjected, the fibre has gradually improved, and now that produced along the coast and on the islands lying off South Carolina and Georgia is considered superior to that grown in any part of the world. The custom of carefully selecting the seed has grown with the industry, and may be said to be inseparable from it, and it is only by such careful selection that the staple can be kept up to its present superior excellence. Several different strains have been developed, and are maintained by different growers selecting with different ideals in view. . . . This method and similar ones employed by numerous other growers are applicable, with slight variations, to most of our common crops, such as corn, wheat, etc.*

About 1,785 seeds of this cotton were brought to Georgia from the Bahamas. Notwithstanding the good care they received and the mild winter, the plants were killed down, but they came up again from the roots, and with this start succeeded in ripening a few seeds before the first frost in the fall. The earliest of these seeds were sown in turn, and by continuing this process of selection the flowering period became earlier and earlier, until now the plants ripen a large portion of their seeds before frost, even along the coast of Carolinas. Besides striving to obtain earlier maturing sorts, very careful selection has for years been made with a view to increasing the length, fineness, and strength of the

* Yearbook, Department of Agriculture, 1898, p. 358.

staple. The selection is regularly practised by all intelligent growers, and to-day it may be regarded as one of the necessary cultural methods. Every year a special patch of cotton is grown from selected seed; the plants in this patch are examined very carefully and the seed of the best individuals retained for planting a similar patch next year, the seeds of the remaining plants being used to plant the general crop. Under such continuous and rigorous selection the length and fineness of the fibre have gradually increased until it is recognized as superior to that grown anywhere else in the world and commands the highest price in the market.*

With the object in mind of breeding an early-ripening variety of the roselle, the breeder might find it expedient to harvest some of the seed before it is fully mature, as it has been shown that plants from green seeds—tomatoes, for instance—have a tendency to mature fruit earlier than plants from ripe seeds.

FUNGOUS DISEASES AND INSECT ENEMIES.

The only disease that has so far been noted on the roselle is a mildew (*Oidium* sp.) which attacks all parts of the plants above ground, and under favourable conditions appears capable of doing considerable damage in discolouring the fruit and in lessening the vitality of the plant. Where its presence was noted, however, the greater part of the crop was gathered before the mildew made its appearance, making the loss of fruit comparatively small. Experiments have not been made to find a remedy, but sulphuring the plants would probably be found to be effective. Bordeaux mixture would without doubt prove efficacious, but would also in all probability tend to discolor the manufactured product.

The most serious enemy of the roselle is the root-knot nematode (*Heterodera radicicola*). A cheap and effective remedy for this pest has not been found, and infested land should not be planted with the roselle.

The soft scale (*Coccus hesperidum*) has been noted on the roselle, but has not yet assumed the character of a pest. Its activity is restricted to the stem and lateral branches close to the ground. The scale is distributed by a small black ant.

The cotton stainer (*Dysdercus suturellus*) has been observed on the plants in limited numbers, but does not appear to be injurious.

The yellow aphis (*Aphis gossypii*) has been known to do considerable damage on individual plants by attacking the leaves and flower buds and causing the calyces to drop. It has not, to the knowledge of the writer, appeared as a serious pest. Remedies for this species, better known as the melon or cotton aphis, are considered in Circular No. 80 of the Bureau of Entomology of this Department.

SUMMARY.

The roselle is an annual from the Old World Tropics.

It is extremely sensitive to frosts, and can at present be grown for its fruit only in tropical and subtropical countries.

Being easily cultivated when the climate is favourable, the roselle should be in the garden of every family, and on account of its excellent qualities for making jellies, jams, etc., it is certain to become an important plant in the manufacture of those products.

The young stems also make good jelly. For such use the plant can be grown almost anywhere in the North or South.

By proper methods of breeding it is possible to obtain strains with larger calyces. Probably earlier bearing races can also be obtained by careful selection of the earliest flowering plants.—*U. S. Department of Agriculture, Farmers' Bulletin*, October 24, 1907.

CACAO IN ECUADOR.

The September number of the *Mexican Investor* contains the following particulars with regard to the production of cacao in Eucador:—

The principal product of Eucador is cacao, of which it furnishes nearly one-fifth of the world's production, which is now estimated at 300,000,000 lb.

The cacao tree grows on the warm lowlands and in the valleys tributary to the coast. The valleys adjacent to Guayaquil produce the greatest quantity of any district in the world. In 1900 there were 4,827 cacao plantations or farms in Ecuador, with a total of 58,551,142 trees. The yearly production in pounds was: In 1900, 41,134,000; in 1901, 51,311,000; in 1902, 53,621,300; in 1903, 49,921,300; in 1904, 61,339,000; in 1905, 47,225,400; and in 1906, 51,690,500.

Guayaquil cacao has special characteristics of its own, both in shape and in aroma, and is easily distinguished from the cacao of other districts. The lower grades are very strong and coarse in flavour, while the better grades contain a large percentage of theobroma, making them more valuable. Here the cacao is divided into two classes, viz., up river

* Yearbook, Department of Agriculture, 1899, p. 490.

(arriba) and down river (abajo); to the latter class belong the grades known as Machala, Balao, Naranjal, and Tenguel.

The cacao coming from the plantations situated in the up-river district is far superior and always sells at higher prices.

The value of the annual exports of Eucador, in round numbers, amount to $8,000,000, two-thirds of which is cacao. The planting and cultivation of the cacao tree is being carried on more extensively every year, as it is the general opinion that the article has a splendid future, and that the present production is not sufficient to meet the growing demand for consumption.—*The Agricultural News*, Vol. VI, No. 144, November 2, 1907.

TEA IN FRENCH INDO-CHINA.

BY M. DYBOWSKI, ABSTRACTED BY J. C. WILLIS.

M. Dybowski begins by remarking that the consumption of tea in France is rapidly growing, and that French colonies should help in the supply. Th export from Indo-China was 168,00 kilos in 1903 and 327,000 kilos (720,000 lbs.) in 1904, while the consumption in France for the corresponding years was 1,020,500 and 1,109,600 kilos.

Indo-Chinese tea is as yet all used in blending with coarser grades, its good points being in its aroma, its stimulating qualities, and small amount of astringents.

A comparison of analyses of this and of Ceylon tea shows :—

	Indo-China Tea.				Ceylon Tea	
	Tonquin Pekoe.	Extra Pekoe.	Superior Pekoe.	Pekoe.	Pekoe 2.	Pekoe Souchong.
Caffein	2·82	2·34	2·40	2·24	2·04	2·30
Tannin	0·209	0·255	0·255	0·558	0·488	0·488
Dry matter	89·28	88·60	88·55	90·28	89 50	89·73

These analyses show a superior caffein content, and a reduced quantity of tannin.

OILS AND FATS.

CITRONELLA OIL.

The prices of this important oil have now for some months been moving slowly downwards, and at this moment have already arrived at 1s. 5d. per lb. c.i.f., whereas early in April the tendency was still extremely firm, and no oil could be bought below 1s. 10d., owing (it was said) to very short supplies which scarcely sufficed for carrying out previous contracts, the prices went down a few weeks afterwards to 1s. 9d., and since then have fallen without intermission. The export-figures for January to September are as follows :—

1906	...	771,416 lbs.
1907	...	855,826 ,,

According to these, an excess of 84,410 lbs. as compared with the previous year has now to be recorded. Under normal conditions such a surplus would hardly depress the market, but in the present year the situation is in so far abnormal, that the soap industry, particularly in the United Kingdom, has purchased less than last year, which has led to an accumulation of stocks in the European markets.

As a consequence the general tendency is weak, and in spite of the approach of the monsoon, which will interrupt the distilling season, we consider cheaper prices not at all impossible. It has lately become more difficult to form an opinion on the probable movement of the prices owing to the fact that in the last few years the bulk of the trade in citronella oil in Ceylon has become concentrated in the hands of three important native traders, who work almost exclusively with the export firms at Galle. If these three traders should work together, it would, of course, under favourable conditions be possible to keep up the prices artificially.

Induced by the high prices which, as already reported by us, were due to the speculative action of one firm, a large number of planters in Java have again taken up the distillation, and the sources supplying Java citronella oil, which had given out long since, have recently again commenced to flow. As long as the consumers are able to absorb the supplies straight away, a fall in the prices is out of the question, but signs are not wanting that it is found a difficult matter to interest buyers in forward shipment at the present quotations.

It may engage the attention of our readers to learn that a factory has recently been established in Java, which is intended to work up the grassy residues resulting from the citronella oil distillation, into paper. Some ten years ago we already occupied ourselves thoroughly with the question of this utilisation, and we are pleased to know that it may now be reasonably expected to see the idea carried into practice.—*Semi-Annual Report of Schimmel & Co.*, October, 1907.

THE KUS-KUS ROOT.

The plant has been used medicinally for Asiatic cholera. Its taste and smell are due to an ethereal oil termed in pharmacy "Oleum æther' Vetiveriæ." This is used in perfumery in India, and also in Europe. The oil occurs principally in resinous material lying in a layer of cells just internal to the endodermis, and also in the parenchymatous cells forming the septa of the cortex. In many vessels and broken-down groups of cells, it occurs as a yellowish-brown mass, which when treated with alkalies resolves itself into drops of an oily resinous substance. The ethereal oil is steam-distilled from roots which have previously been macerated in water.

The yield of ethereal oil is from 0·4 to 0·9 per cent. The specific gravity of the oil is 1·02 to 1·03 per cent. It is soluble in 80 per cent. alcohol. The oil is very thick and tenacious, varying in colour from green to straw-yellow, yellowish brown and dark brown. In India the long adventitious roots are used for making mats, and are also ground into powder which is placed among clothes to prevent attacks of moths, etc.—*Agricultural News*, Vol. VI., No. 146, November 30, 1907.

SESAMUM IN BURMA.

Next to paddy the most important crop in Burma is sesamum, commonly known as til or gingelly. Sesamum is essentially a wet weather crop, but it can be cultivated wherever the plantain thrives, and as a matter of fact the crop is grown in almost every district in the province, the largest areas under sesamum being met with in the dry zone. As a cold weather crop it may be grown on low, moist soils, in districts where there is a heavy dew, but here the yield

is not so great. Having selected a piece of highland of a light, sandy nature on which water will not stagnate during the monsoons, all the growth should be cut and burnt and the land should then be well ploughed once in the month of April. The field should then be dressed with refuse, cow-dung, silt from creeks or tanks, and after the first showers in May it must be ploughed twice and all clods well broken by means of a *kyan*, an implement used in husbandry to level the ground; then harrowed until the field is well levelled and broken to a fine tilth. Then a five-teeth harrow is taken, two-teeth knocked off leaving only the end and middle ones, and the harrow run straight across the field. Where, however, the field slopes the furrows are run in the direction of the slopes so that the water may easily drain off. The field is now marked in furrows about a cubit apart and is ready for the reception of seeds. As soon as the rains set in the seeds should be dibbled in the furrows as near as possible, say about one cubit apart, and covered lightly with a little earth. Care should be exercised in selecting only the best seeds; seeds of a bright, brownish black colour and well formed are the best, and if the eight ribbed kind is procurable this should be selected for sowing as its yield is much higher. Nothing further is needed till the plants are about six inches high when weeding should be done with a hoe. All blanks should now be filled up, and plants that are too close together should be pulled up in order to make the yield even. Beyond keeping the ground well weeded no further operations are needed till the crop is gathered. As soon as the pods begin to turn yellow the crop should be cut, as once the pods dry the seeds will drop and portion of the crop is lost. The plants are cut with about a cubit of the stalk and heaped upon a mat under shelter for two or three days until they are slightly fermented when they are put out in the sun, pods upwards, against a bamboo raised a foot from the ground, and as the pods dry and open the seeds should be shaken into a basket. This operation is repeated till all the seeds have been removed from the pods and the seeds are gathered, dried from the sun for a day and well cleaned. The quantity of seeds required to sow an acre of land is three viss, while the yield is from 20 to 30 baskets, *i.e.*, from 80 to 120 fold, in the proportion to the care and attention bestowed on the cultivation. Well-grown black seeds fetch Rs. 4 a basket, and as one pair of bullocks is sufficient to work and cultivate the paddy-fields besides, for paddy, is sown after the sesamum is in the ground, a net profit of about Rs. 100 per acre can easily be calculated on.

To show the importance of the crop to this province the following statistics showing the acreage under sesamum during the six agricultural years ended 1906-07 may be quoted: 1901-02, 825,888 acres; 1902-03, 968,505 acres; 1903-04, 993,679 acres; 1904-05, 1,036,678 acres; 1905-06, 929,122 acres; 1906-07, 950,531 acres. There are two distinct sesamum harvests, that of the early sesamum or hnangyin or hnanange and that of the late sesamum or hnangyi, the former being more generally grown. The latter is sown towards the close of the rainy season after the paddy harvest and reaped during the cold weather, and is hence practically only about 2½ months in the ground, while the hnyangyin, which is gathered during the rains, is a six-month plant. The plants, when mature, range in height from two to five feet and bear white flowers. Sesamum is cultivated for the sake of the seed which yields an oil much affected by the Burmese in cooking. Oil presses on the pestle-and-mortar principle, usually worked by bullocks, are common in most villages where sesamum is grown. The yield of oil varies greatly according to the kind of crop sown. In Tharrawaddy a basket of seeds of the hill variety when expressed produces six viss of oil against five viss produced by the variety grown in the plains, while in Tavoy a basket of hnangyi, grown in taungyas yields 7½ viss of oil compared with a yield of 9 viss from hnanage, but the average yield of a basket of hnangyi and hnangyin may be taken five viss and four viss respectively. Calculating on this basis and taking the average yield per acre as 25 baskets, the quantity of oil that would be expressed from the produce of 950,000 acres works out to about 48,374,720 gallons. It is curious, notwithstanding this fact, that quantities of both seed and oil are annually imported into Burma, which greatly exceed in amount the exports.—*Indian Agriculturist*, Vol. XXXIII., No. 1, Jan. 1, 1908.

SUGAR AS FOOD.

The London *Lancet*, a well-known medical authority, says: "It seems inconceivable that the bountifulness with which the world is supplied with sugar should mean anything else than that it is designed for human food. Sugar is one of the most powerful foods which we possess as it is the cheapest, or at any rate one of the cheapest. In muscular

labour no food appears to be able to give the same powers of endurance as sugar; and comparative practical experiments have shown without the least doubt that the hard physical worker, the athlete or the soldier on the march is much more equal to the physical strain placed upon him when he has had included in his diet a liberal allowance of sugar than when sugar is denied to him. Trophies, prizes and cups have undoubtedly been won on a diet in which sugar was intentionally a notable constituent. It has even been said that sugar may decide a battle, and that jam, after all, is something more than a mere sweetmeat to the soldier.

"The fact that sugar is a powerful 'muscle food' accounts probably for the disfavour into which it falls, for a comparatively small quantity amounts to an excess, and excess is always inimical to the easy working of the digestive processes. A strong solution of sugar is irritating to the tissues, will set up superficial inflammation and may produce a form of eczema. It is well known that an excessive diet of sugar irritates the mucous membrane of the stomach and encourages the production of mucous and of a highly acid gastric juice.

"The ingestion of much sugar spoils the appetite. Children who have been tempted to over indulge in 'lollipops' between regular eating times do not want their ordinary meal. The schoolboy spoils his dinner by eating too many sweet things before that meal. An over-indulgence in sweet liqueurs, in sweet ices and in 'crystallized' fruits after retards the digestion of the meal.

"Sugar satiates; it is a concentrated food. When sugar does harm, therefore, it is invariably due to excess. Taken in small quantities and distributed over the daily food intakes, sugar contributes most usefully in health to the supply of energy required by the body. In certain diseases, of course, the presence of sugar in the diet is plainly undesirable. Generally speaking, however, there is a prejudice against sugar which is not justified by physiological reasoning—at all events, when it is eaten in moderation; and it is a curious fact that the man who practically abstains from sugar, or reduces his diet to one almost free from carbohydrates in favour of protein foods such as meat, often shows feeble muscular energy and an indifferent capacity for physical endurance."—*Bradstreets.—Louisiana Planter and Sugar Manufacturer*, Vol. XL., No. 6.

DRUGS AND MEDICINAL PLANTS.

HINTS FOR TOBACCO GROWERS.

BY C. DRIEBERG.

The following notes which should prove useful to all cultivators of tobacco are chiefly based upon a very practical bulletin issued by the Agricultural Bureau of the Philippines, and will be embodied in a leaflet to be issued in English, Sinhalese and Tamil :—

SOIL.—A fine sedimentary or alluvial soil is calculated to raise the best tobacco. A rich dark soil containing a good deal of lime produces a rank growth and dark leaf ; a light sandy soil as a rule produces a thin and small leaf of light colour. Trifling differences in soil show marked influence on the quality of leaf. Soil preparation should be thorough.

MANURE.—Tobacco rapidly exhausts a soil. Nitrogen is best supplied by a leguminous crop such as cow pea, green gram, etc., which should be grown on the land and ploughed in. Tobacco stalks which contain about 3·5 per cent. potash should, if possible, always be returned to the soil.

The following mixture is recommended :—Coconut poonac seven parts, double supherphosphate of lime one part, tobacco stems and waste twelve parts. This should be applied at the rate of about 15 cwts. per acre. Where tobacco stalks etc. are not available the potash is best applied in the form of sulphate. Kainit and chloride of potash (as well as common salt) are not recommended as they produce a leaf that does not burn freely owing to the chlorine they contain.

SEED.—There should be two or three nurseries sown at intervals of 15 days. The seedlings should be brought to a very vigorous condition before transplanting. Always " burn " when preparing a nursery. The young plants like the ash, which keeps them free from fungoid diseases. To keep ants from attacking seed when sown, mix the seed with corn meal, one ounce seed to one pound meal. The meal will occupy the ants till germination of the seed when it loses its sweetness. After sowing, the soil should be pressed down with a heavy plant or light roller, and covered with bamboo brush to prevent splashings when rain comes.

DISTANCE OF PLANTING.—This is a very important matter. Distance will depend on nature of soil and the purpose for which the leaf is required. By planting close and giving attention to cultivation of the soil and to manuring so that the lower and middle leaf leaves tearing shade, each other, or thin leaf free from heavy veins, which when cured properly should be lustous and elastic is produced. This result is brought about generally at the expense of flavour which, however, is not of any importance in the case of a wrapper for which such leaves are essential.

For filler tobacco the distance would be greater. For instance, while tobacco for wrapping might be planted as close as 2½ feet each way, filler tobacco being on average placed 3¼ feet each way, or at the rate of 3,850 plants per acre.

CULTIVATION.—Soil preparation should be very thorough and after cultivation should be perfectly clean, so that continuous tillage is necessay. Where, as in Ceylon, tobacco gardens are not very large, the Planet Junior type of cultivation for hand power will be found invaluable. Tobacco, being a shallow-rested plant, takes the bulk of its nourishment from the top layer of soil, so that frequent shallow cultivation is necessary to keep the moisture near the surface in dry weather.

INSECT ENEMIES.—To keep the tobacco worm in check, it is recommended that an occasional plant of datura should be planted out with the tobacco. A few drops of honey or syrup poisoned with cobalt and placed in the tubes of the flowers attracts and kills the dusk-flying moth in great numbers before they deposit their eggs.

TOPPING.—This is a very important operation. Speaking generally, topping should be done in inverse ratio to the vigour of the plant, *i.e.*, a weak spindly plant tree should be cut heavily back, so that all its strength may be circulated in the production of a few (say 6) good leaves ; while on the other hand a strong robust plant will merely require the tip to be pinched, so that it may perfect almost all its (say a dozen) leaves. The plant which carries many leaves will generally produce thin and elastic leaves, while heavy topping as a rule induces large coarse heavy veined leaves full of essential oil and resin. The finest tobacco is produced by topping and suckering, *i.e.*, at the time of topping any sucker starting from the lower stem is cut back and the lowest two or three leaves also removed. The removal of these latter as well as the top suckers concentrates the growth on the central

8 or 10 leaves which produce the highest quality of tobacco. When these ripen, however, one or two suckers might be permitted to start from the bottom so as to furnish a second crop, which if treated and fertilized like the original plant yield a valuable aftermath.

HARVEST.—The removal of only ripe leaves, though troublesome, yields the best results. A ripe leaf could be easily recognised by the trained eye. If the leaf be pinched on the mid-rib folded back, it should crack instead of bending. Rarely more than two or three leaves are ready to cut for a stalk at one time. The leaves from different cuttings should be kept separate.

CURING AND FERMENTING.—Tobacco *must* be dried slowly, and to this end they should be hung in quantity close together on poles in a roomy drying shed, the position of the leaves being reversed so as to produce a uniform result. After this process of curing must come fermenting. If properly carried out it is often possible to eliminate many of the worst qualities from a rank coarse tobacco by careful attention to fermentation. It is important that leaves in the same state of dryness should be fermented together. The common practice of piling the leaves in heaps of two or more feet thick is to be recommended. A thermometer will at once indicate a rise of temperature above which the heap should be broken up and a fresh heap formed with the centre leaves outside. Experienced men can say if there is too much heat by merely plunging the hand into the centre. A perfect fermentation will develop colour, gloss, flavour, etc. Two or three fermentations are to be recommended. The mixing of dry and damp tobacco will spoil the whole mass.

SEED.—To get good seed protect the flowers of selected trees from cross fertilization by means of paper bags. To preserve seed mix with five times its bulk of powdered charcoal and put it in a tightly corked bottle.

DISEASES.—To complete these notes on tobacco, the following extracts are taken from a Circular on Tobacco Disease by Mr. T. Petch, Government Mycologist :—

ROOT DISEASE.—This disease is known as *paluppu* (Tamil), and is naively described by the cultivator as "sudden and premature ripening." It is certainly sudden, and, from this point of view, premature. The stem becomes discoloured at the base, and all the leaves dry up. The disease spreads to the surrounding plants, killing them out in patches all over the field. Frequently white ants attack the dying stem and eat away the diseased parts. The distribution of the diseases shows that it is caused by a root fungus, and this is confirmed by microscopic examination. *Treatment.*—The diseased plants must be uprooted and burned, and the places where they are grown should be forked over with a liberal dose of quicklime.

LEAF DISEASE.—Two kinds of "spot" diseases (*pulli*) are distinguished by the growers, but they do not consider them very serious. In one form the spots are brown and dry and sometimes zoned. The fungus on these is *Cercospora.* A similar fungus has been named *Cercospora nicotianoe* in America, and Racibroski decided that the Javan species was the same, but the latter has recently been named *C. rasiborskii* on the ground that the spores are twice as long. Spores of Ceylon specimens developed in a tin are half as long again as the Javan form, but all these differences are merely accidents of development, and the fungus is most probably the same in all cases. In the other form of *pulli* the spots are white. I have not yet been able to determine whether they are caused by a different fungus. *Treatment.*—Bordeaux mixture, copper carbonate, or sulphur has been recommended for this disease in America, but there are obvious objections to the use of these. The use of potash fertilizers has also been advocated.

"ASH."—"The worst form of all enemies to tobacco is the disease called 'ash' (*alu* or *sambal*) which attacks the plant from the lowest leaf and works its way upwards. The leaves are totally covered with a white substance like ash, and hence its name. The leaves attacked by this disease become quite dry, and retain their white ashy deposit even in the cured state."—(C. Rasanayagam.) This disease is caused by one of the "mildews," the group of fungi which includes the worst parasites of the hop and the grape vine. *Treatment.*—Sulphur is the recognised and proved remedy for all the mildews. But it is scarcely possible to apply this to the tobacco leaf, if the leaf is to be used for smoking afterwards. The "ash" grows on *Cassia tora* (Peti-tora S., Vaddu takari T.), *C. occidentalis* (Peni-tora S., Ponnan takri T.), *Tephrosia villosa* (Bupila S.), *Euphorbia hirta* (Budadakiriya S., Palavi T.), seedling tamarind (Siyambala S., Puli T.), tomato, red pumpkin, and slightly on *Jatropha curcas.* The first four plants are worst affected, and they are all common weeds. Now, it is unlikely that the resting fruit occurs in tobacco; it probably is formed on one of the common weeds which persist

throughout the year. *Treatment.*—The tobacco fields should be kept clear of weeds. In no other way will it be possible to keep tobacco free from "ash."

CURLED LEAVES.—These are known as *suruttal.* The edge of the leaf is usually curved in towards the under surface, and the green portions between the veins bulge out as though they had outgrown the spaces allotted to them. This crumpling is caused by swellings on the veins; these can be seen on the under-surface of the leaves. There seems no reason to suppose that these are due to insects or fungi. These leaves are quite unsaleable, and, therefore, the plants which produce them are often kept for seed. This practice cannot be too strongly condemned.

MOSAIC DISEASE.—The affected leaves are yellowish green in patches, so that the leaf is mottled with light and dark green. In some cases the form of the leaves is altered, and they become strap-shaped, about 12 inches long, but only one or two inches wide; these narrow leaves are often yellow with green veins. On some leaves the patches are quite white and more angular. These three appearances are known by the growers under different names, but they are regarded in other countries as only forms of the same disease. It has been shown that the disease is contagious, but not infectious; it can be transferred by first handling a diseased plant and then a sound one. The burning qualities of "mosaic" leaves are poor; they burn with a disagreeable, penetrating odour, and therefore cannot be used for pipe tobacco. Possibly the presence of mosaic disease accounts for the flavour of Ceylon tobacco; it must be remembered that affected leaves do not wither, but are harvested and cured with the good ones. Tobacco is free from this disease when it is grown on newly-cleared jungle land, but the disease always appears after two or three years, when the same land has to be used again. When mosaic disease makes its appearance in a field before topping, care should be taken to top all the healthy plants before touching the diseassd ones.

FIBRES.

ZAPUPE FIBRE PLANT.

In continuation of the note published in the *Kew Bulletin*, No. 5, 1906, p. 190, the following report by Mr. L. J. Nunn, British Vice-Consul at Vera Cruz Mexico, which we have received through the courtesy of the Under Secretary of State for the Colonies, is of considerable interest.

It is suggested that Zapupe might be profitably introduced into the West Indies and other tropical colonial stations, but at present, unfortunately, we are still ignorant of the specific identity of this *Agave.*

A small plant, grown from one of the bulbils referred to in the previous note, is making good growth in the gardens.

Letter from the British Vice-Consul, Vera Cruz, Mexico, to L. J. Jerome, Esq., His Majesty's Consul, Mexico.

Vera Cruz, 20th June, 1907.

Sir,—In view of the increasing attention that is being given to the cultivation of the Zapupe, a fibre-producing plant similar in most respects to the Henequen or Sisal hemp, the source of so much wealth to the planters of Yucatan, I have the honour to transmit herewith a short report on its cultivation and uses, more especially as compared with the Sisal, as I believe, from the nature of the soil in which it is raised in this State, that it might be profitably introduced into some of the islands of the West Indies and other parts of the Empire within the tropics.

I have, &c.,
(Signed) L. J. NUNN,
British Vice-Consul

The Cultivation and Uses of the Zapupe in Mexico.

Of the many experiments that have been made with fibre-producing plants to discover one that would equal for production and results the Henequen or Sisal of Yucatan, all seem to have given but little result with the possible exception of the Zapupe, to the cultivation of which, in a limited way, a considerable degree of attention has been devoted in the State of Vera Cruz during the last three or four years. Attempts have been made, as is well known, in various parts of the world, but more especially in some of the islands of the West Indies, to raise Sisal or Henequen, but in general these attempts have been failures, the consensus of opinion being that there are certain peculiarities in the barren and arid plains of Yucatan, which, together with climatic conditions, render the land unrivalled for the cultivation of this particular class of hemp-producer. It would seem, however, that in the Zapupe a rival to the Henequen or Sisal has been discovered, that can be produced under equally as economical conditions, and which will give as good if not better results under more varied conditions of soil and climate.

Botanists, it would appear, have not yet decided on the exact classification of the Zapupe, and although it resembles in many points the Henequen, it can only be said that they are both of the Agave family.

The first experiments in the cultivation of the Zapupe were undertaken in the year 1901 or 1902 on a small scale, on some lands cleared for this purpose in the Canton of Tuxpan, in the State of Vera Cruz, where it is found in its wild state, and it is estimated that in the same vicinity there are now set out over five million plants in various stages of growth.

The cultivation of the plant requires no particular skill nor does it require much attention, a point of considerable moment in countries where labour is scarce and apt to be unreliable. The usual methods adopted are to take the young shoots when they are but a few inches high, cut them clear from the parent plant and set them out in carefully prepared nurseries, where they are allowed to remain from eight to ten months, by which time they will have assumed a height of from a foot to two feet above the ground. At this stage they are then transplanted to ordinary lands, all the preparation required being to turn the ground up with a plough and set the young plants in the furrow, banking the soil up around them so that they may be well covered. One of the reasons for this is that when the young plants are lifted from the nursery all the roots are cut off that part where the roots should be resembling more or less the sharp end of a tent peg, so closely are they cut down. As a rule, the furrows are run in the usual parallel manner, about seven feet apart with a distance between each plant of about five feet, which would give a little over one thousand plants to the acre. Between three and four years subsequent to transplanting the plant will bloom unless pruned, when flowering will not take place for a matter of fifteen years. In order to increase the fibre-producing power of the plant, the flowering period must be kept in check as long as possible.

At from four to five years old the cutting of the leaves can be begun, the plant continuing to produce for a term of

eight to ten years. Cutting takes place three times a year, each yield per individual plant being from about twenty-five to thirty leaves, the weight of fibre per leaf amounting to probably not quite half an ounce, so that each plant would give per year about two and one-half pound of fibre.

From three years and onwards each plant will give off anywhere from two to a half dozen shoots, and, if allowed to flower in its early stage, from the stalk which runs up from the centre to a height of twelve feet and more, it is possible to cut a hundred or more slips.

Although up to the present no extensive plant has been erected for the treatment of this fibre by machinery, there is little doubt as to the confidence in its future possessed by those engaged in its cultivation, for whereas experiments as to the possibility of its uses and production were only begun in 1901, it is safe to say that at present there are fully four to five thousand acres of ground now cleared and set out with four to five million plants in various stages of growth.

The best localities for the cultivation of Zapupe are gently sloping plains or mountain foothills, with a soil fairly rich to poor and of not too porous a nature. Drainage must be good, as if the plants get set too long in stagnant water the roots will rot and in general the growth and production of fibre will be retarded. As the plant is essentially tropical, it is perhaps needless to say that its cultivation at any considerable altitude is an impossibility; the best results in fact will be obtained where the atmosphere is warm and humid and with but slight variations in the temperature. A too sandy soil should be avoided as absorbing too quickly the surface moisture on which the shoots, especially from the parent plant, are dependent. A clayey soil again is equally bad, as it seems to cause the roots to double and break in their endeavours to spread.

A rough estimate would show that the outlay for tending the young plants in the nursery, preparing the ground for transplanting, together with cost of the plants would be approximately:—

Shoots per 1,000	$35·00
Sowing and tending in nursery per 1,000	7·50
Preparing ground and planting	7·50
Total ...	$50·00

Up to the present time the general uses to which this fibre has been applied have been limited to the making of food and game bags, lariats, and a species of gunny cloth, but more recent experiments have demonstrated its adaptability for working up into rope, and it is on this ground that several local companies have been formed and are projected for the raising of this plant on a large scale in order to compete with the Henequen or Sisal hemp growers of Yucatan, in the production of a rope-making fibre.

Comparison between the respective merits of Sisal hemp and Zapupe from the point of view of the cultivator show many points in favour of the latter if, as is hoped, the fibre of the Zapupe should prove to be equal for commercial purposes to that of the Sisal. For example, the rapid growth and development of the Zapupe is quite extraordinary. In from three to four years, in many cases, the plant will have arrived at a stage where the gathering or cutting of the leaves may be taken in hand whereas the Henequen or Sisal takes fully six years to arrive at a condition of sufficient maturity to permit of the cutting of the leaf.

From the point of view of yield of fibre the difference in favour of the Zapupe is again very marked, as the following data will show:—

	Zapupe.	Henequen or Sisal.
Plant ...	1	1
Yearly yield of leaves ...	80	25
Cuttings per annum	3	2
Weight of fibre per leaf	½ oz.	1 oz.
Product ...	2½ lbs.	1½ lbs.

It will be seen from the foregoing that the Zapupe will yield in a year fully a third more weight of fibre than can be obtained from the Sisal, but on the other hand the labour and increased work entailed makes it doubtful whether the revenue derived from the extra weight of fibre produced by the Zapupe would not be more than swallowed up by the excess occasioned in expenditure. For instance, in the Zapupe three cuttings per year are necessary. Eight leaves have to be culled and carted to the decorticating machine. The eighty leaves have to be put through the scraper three times, and the refuse to be removed is equally as great in volume, whereas with the Henequen or Sisal there are only twenty-five leaves per plant to handle from the plantation to the machine shed, the same results are obtained with two scrapings as are produced by three in the case of the other plant, so that it remains quite a question as to whether the larger quantity of fibre obtained really does offset the increase in expenditure that so

much extra labour must entail, and scarcity of labour in the hotlands of Mexico, especially near the coast, is and probably will be for many years to come the most formidable difficulty that the planter of this and other produce has to contend with.

It must, however, also be borne in mind that the cultivation of the Sisal is one to which for the last thirty years and more the closest study has been given, and every possible experiment tried, with the object of increasing the yield and effecting, by improved machinery, economies in the expenses of treatment, the result of which has been that whilst sale prices have remained at a most profitable figure, the cost of production has steadily decreased.

That there is a bright future for those engaged in the production of Zapupe, there can be but little doubt, the value of the fibre having being proved beyond the experimental stage, in addition to which it has been shown that it possesses both for toughness and tensile strength, the necessary qualities to admit of its being worked up into "binder twine," and even more profitable use than its manufacture into rope. As a matter of fact, probably over ninety per cent. of the Sisal to-day produced and exported from the peninsula of Yucatan to the United States is made into "binder twine," and even with this there is a constant demand for other raw materials as substitutes.

It may prove of interest to prospective Zapupe planters to learn the gigantic strides that have taken place in the production of Sisal during the last twenty-five years, which are shown by the following table showing the quantities and value of the exports of this produce from Yucatan alone. It is also worthy of note that at its lowest selling price of three-and-a-half cents Mexican per pound (the Mexican cent is about equal to one farthing), there was still a margin of profit to the planter, whose gains were simply notorious throughout the country when the maximum price of nineteen-and-a-half cents Mexican per pound was attained :—

Years.	Number of Bales.	Weight in Metric Tons.	Total value of Exports. £.
1880 ...	112,911	18,179	177,757
1881 ...	154,730	24,911	272,656
1882 ...	150,585	24,244	273,655
1883 ...	202,805	32,651	353,750
1884 ...	261,137	42,043	347,164
1885 ...	267,478	43,064	333,481
1886 ...	242,791	39,089	392,972
1887 ...	224,865	36,283	589,412
1888 ...	218,129	35,118	664,125
1889 ...	252,432	40,641	1,024,369
1890 ...	279,907	45,079	523,030
1891 ...	323,585	52,065	657,168
1892 ...	363,881	58,584	839,994
1893 ...	360,857	58,097	846,713
1894 ...	373,773	61,605	684,817
1895 ...	383,413	61,729	611,219
1896 ...	397,163	65,762	726,423
1897 ...	419,975	70,545	821,869
1898 ...	418,972	68,834	1,891,807
1899 ...	445,978	73,190	2,021,124
1900 ...	499,634	81,093	2,261,603
1901 ...	517,519	83,191	2,278,345
1902 ...	528,246	83,993	3,643,279
1903 ...	590,430	93,058	3,333,115
1904 ...	606,008	97,205	3,202.258
1905 ...	597,289	96,534	2,692,543
1906 ...	599,568	97,198	2,724,752

—*Royal Botanic Gardens, Kew Bulletin*, No. 10, 1907.

THE SISAL FIBRE INDUSTRY IN QUEENSLAND,

WITH NOTES ON MAURITIUS HEMP, MURVA, AND THE MEXICAN ZAPUPE FIBRE.

BY A. J. BOYD.

A very full account of the plant and of the methods concerned in its growth and the production of the fibre. We are limited by considerations of space to the following extracts :—

Allowing 1,000 plants to the acre, each plant at four years gives forty leaves a year, of a weight of about 120 lb. This has been shown to be the average weight of leaves in Queensland. In Yucatan, the weight averages about 1 lb. 10 oz. Let us take the lesser weight as a basis for a calculation of returns—that is, 50 lb. as the weight of forty leaves. Four per cent. of this turns into marketable fibre, dried and white, or 2 lb. of fibre per plant. This gives us 2,000 lbs. to an acre. The value of the fibre in the Melbourne market is at present (1906) £37 10s. per ton, f.o.b., at Brisbane. We will, however, take £35 as the market price. An allowance for cultivation, preparation, baling, and carriage to a Queensland port of 40 per cent. on the value of the fibre is considerably in excess of the truth—40 per cent. on £35 is £14. Deducting this from the sale price, the net proceeds per acre amount to £21. The planter will, however, do well to reckon for a first crop upon about half ton of fibre per acre; 40 per cent. on the sale price, £17 10s., reduces this to £10 10s., which represents the net profit per acre.

Consumption of Sisal Fibre.

fluctuation in prices.

During the eleven years between 1894 and 1905, the following quantities and values of the importations of sisal into the United States will show the magnitude of the industry :—

Year.	Tons.	Value.	Average price per ton.	Market prices for best samples.
		£	£ s. d.	£ s. d.
1894	48,468	748,414	15 9 2	—
1895	47,596	548,679	11 19 11	—
1896	52,130	682,552	13 1 11	16 6 8
1897	63,266	766,946	12 2 6	27 18 4
1898	68,322	1,033,980	14 2 5	34 4 2
1899	71,898	1,840,275	25 13 0	35 8 4
1900	76,921	2,454,638	30 13 2	
1901	70,076	1,660,950	22 16 8	32 11 8
1902	89,583	2,491,919	26 16 8	43 1 8
1903	87,025	2,789,634	30 11 3	36 6 8
1904	109,214	3,319,907	30 7 9	40 6 8
1905	200,000	8,265,819	35 0 0	35 0 0

The exports of fibre from Yucatan, in 1903, amounted to 590,430 bales, of a value of £3,333,114. In addition to this, Mexico exported binder twine to the value of £92,595.

In 1904, a sale was effected in New York at £40 6s. 8d. per ton.

In 1906, a Mexican consignment to New York was withdrawn from sale, £39 13s. 4d. per ton being refused.

During the eleven years cited it will be seen that the importation have not only nearly doubled, but the price obtained per ton has, during the same time, increased proportionately, making the value for 1903 approximately five times as much as that for 1894.

During 1905 and 1906 the price per ton has still further advanced, ranging from £35 to £37 10s. per ton, whilst production cannot keep pace with the demand. The reduction of the output of Manila hemp, which latter article usually regulates the hemp market, has had a still further effect in raising the price of sisal, whilst the expansion of wheat-growing industry in the United States, Canada, Australasia, and other colonies indicates a still greater demand for binder twine and a corresponding increase in price.

The principal product of the Agave, however, is the fibre, and one of the most important manufactures from it is binder twine, for which purpose it is better adapted than any other fibre. When we consider the enormous areas under wheat in many parts of the world, we may cease to wonder at the great demand for sisal fibre. The enormous stretches of prairie lands under wheat in the United States of North America, and in Canada, as well as in some States of South America, enable us to understand why £3,000,000 worth of the fibre are annually purchased in New York from Yucatan alone. In Australia we have, approximately, 6,000,000 acres under wheat, and although strippers and complete harvesters are used to some extent, yet thousands of reapers and binders are at work in harvest time, consuming from 2½ to 3, and even 4 lb., of twine per acre. If all this area had been cut by reaper and binder, the total cost of the twine, at 7d. per lb., duty paid, would have amounted to £525,000. The raw material required in its manufacture would total over 10,000 tons, including waste at the rope works. The value of this quantity at £35 per ton would be £350,000, which would have gone into Queensland farmers' pockets in addition to the value of their other crops. It will thus be seen that there is an opening for a very large trade in the product.

An extract of the leaves is used to make soap. A strip of the pole makes a splendid razor-strop, owing to the silica it contains. The roots are used in Europe to mix with sarsaparilla. The fibre makes excellent paper, so does the pith of the flower pole. In fact, sisal is the most highly approved of all fibres for the purpose, as it makes a strong, tough, smooth paper, which feels like oiled paper; and, even when unsized, may be written upon without the ink running.

Summary.

From the foregoing dissertation on the cultivation and preparation of sisal fibre, and from what I have shown as to its peculiar adaptability to our Queensland climate, and what markets are available for the product, the reader cannot fail to come to the conclusion that there is a grand future for the industry in this State. So long as people will not entertain exaggerated ideas of the profits to be derived from sisal cultivation, but will be contented to look upon a yield of half a ton of marketable fibre per acre as an average crop, there is not the least probability of disappointment. It is quite possible to obtain a yield of from 15 cwt. to 1 ton per acre, and judging by the results already obtained here, and by the superior weight of the Queensland leaf, the higher yield is most likely to be obtained. The instance of the heavy yield at St. Helena cannot be taken as one which will be repeated on regularly laid-out plantations.

As to a market for the fibre, there is a large demand for it in the United States, Europe, and the Southern States of the Commonwealth. Japan also promises to be a good market. There is also evidence that the market price has increased in proportion to the increased production, so that it is highly improbable that this generation, at least, will see any great diminution in prices.

The question as to the area of a plantation which will give the best returns is best answered by saying that the larger the area the greater the profit. A plantation of 500 acres is to be preferred to one of 100 acres. This fact, need not, however, deter any one from planting a small portion of his farm with sisal, provided he is in the close neighbourhood of a plantation where large machinery is in operation. For instance, a man plants 20 acres of sisal. This should return 10 tons of fibre, worth, say, £350. He may either sell the leaves to the neighbouring factory, or could have them worked up at a reasonable price. The weight of leaves to produce 10 tons of fibre would be from 250 to 300 tons. This would seem a great quantity to remove, but if we compare it with the tonnage of sugar-cane from 20 acres, we see that a heavy crop of 30 tons of cane per acre would amount to 600 tons. On the other hand, the 600 tons of cane are worth from £300 to £600, or £15 to £30 per acre, less expenses for cutting and loading at 3s. to 4s. per ton, whereas 300 tons of sisal leaves, although producing fibre worth £350, would, deducting 50% for all expenses, be worth about £175, or about £8 15s. per acre. But a farmer, with two sons old enough for field work, could take off the crop himself with a Raspador, which would turn out from 60 to 100 lb. of fibre a day, the cost of labour being retained in the family. It used to be said that only large sugar plantations would pay, but when the large plantations are cut up into small farms, and the central mills are established, it was found that the small cane farmers could make a very comfortable living by selling the cane to those mills, and it will probably be found that the same result will happen in the case of the sisal hemp industry. Many farmers in the United States are said to add from £100 to £300 per annum to their incomes by planting the waste portions of their land with sisal. I do not know what facilities they have for turning out the fibre or selling the leaves, but the fact remains that they derive considerable profit from the industry.

With respect to the merits and commercial value of the *Fourcroya gigantia*, as compared with sisal, it has already been explained that Fourcroya fibre—that is, Mauritius hemp,—is not so valuable as sisal fibre. Still, if sisal plants are not obtainable, there is no reason why the Fourcroya should not be planted. The yield of fibre is large, and the leaves grow to a greater length and are heavier than sisal leaves. On the other hand, the fibre is finer and weaker, and does not possess the lustre of the sisal fibre. There is, however, a good and constant market for it, and to-day (June, 1906) it is quoted in British price lists at £34 per ton.

SHORT DIRECTIONS FOR PLANTING SISAL HEMP AND EXTRCTING THE FIBRE.

1. Lay out the ground with a 12-foot roadway between every 8 rows.

2. Put in the plants in holes 8 feet apart every way.

3. Plant them perfectly upright.

4. There is no need to plough up the whole ground. When any tall grass or bushes grow between the rows, cut them down every three or four months. The plants must have no shade.

5. Plants produce better fibre in unploughed than in ploughed ground.

6. Take off any dead leaves from the plants before putting in. Treat them like pineapple plants.

7. When planting, allow no soil to fall between the leaves, or the plant will rot.

8. In very dry weather give each plant, when planting out, a pint of water. They will take root in a week, and after that will defy dry weather.

9. In old sisal hemp countries suckers and bulbils are put out in nursery. There is no need for this. Put the young plant in its permanent place. Why should you have the labour and expense of two plantings? They come on as well in their permanent places as in a nursery.

10. Do not plant in low or wet ground. Dry ridges suit the plants best.

11. When plants are three years old, a first crop of 8 or 10 leaves per plant may be cut. In four years a full crop of 20 leaves may be cut.

12. The yield of fibre is 4 per cent. of the weight of leaf. A 4 lb. leaf will give 1½ to 1¾ oz. of fibre.

13. If the leaves are regularly cut, the plants will not send up a pole for from 10 to 15 years. When a plant poles, the 200 leaves still left will be lost. But if the pole, at its first appearance, is cut, the plant will live twelve months longer, and all the leaves will be saved.

14. Cut away all suckers, and if no ground is ready for them put them in a nursery for future planting.

15. Leaves are ready for cutting when they droop from a perpendicular to a horizontal position.

16. There is no regular season for planting or harvesting. Both operations may be carried out at any time of the year.

17. A machine for scutching cost about £35 in Europe or Mexico. Hand machines are unworkable, as a high speed (400 revolutions a minute) is required. Use a horse gear or oil engine.

18. With a good machine (the Barraclough or Death and Elwood or Todd) about 8,000 lb. of green leaf can be passed through the drum in ten hours, equal to about 320 lb. of dry fibre per day.

19. About 100 gallons of water are used daily to wash the fibre as it passes through the machine. When the fibre comes out, it is hung upon wire lines in the sun for a few hours, and after a day or two in the shed it is then ready for baling and sending to market.

20. The cost of production is about 1d. per lb. of fibre. Generally speaking, the whole cost from cutting to market is about 40 per cent. of the value of the fibre. That is to say, if you sell fibre at the present market value, £35 per ton, the cost of production will be £14, and the balance profit.

21. The average annual return of fibre is about 10 cwt. per acre for the first year or two, and after that as much as one ton. In Yucatan 1½ tons of fibre were produced from 2-year-old-plants, but this was exceptional, and cannot at all be reckoned on.

22. Melbourne will take 2,000 tons of fibre per annum, and there is a never-failing market in New York, as well as in Germany and France.—*Queensland Department of Agriculture and Stock, Brisbane*, 1906, pp. 35.

SISAL FIBRE.

In a brief note on Sisal fibre communicated to the *Journal d' Agriculture Tropicale* for December, 1907, M. L. Hautefeuille points out some of the errors into which inexperienced planters may fall.

The distance between the plants should be determined, he says, not, as has been suggested, by the fertility of the soil, but from the point of view of convenience in working. This is important owing to the deadly array of spines with which the agave is armed.

With regard to the question of sun drying, he points out the remarkable difference in the power of the sun's rays in different countries, and remarks that if a colony of Cubans were to migrate to Tonkin, they would soon have to adopt the topee which they so much despise.

His third point is with reference to the terminology. *Agave americana*, he says, has been mistaken for *A. rigida* (*sisalana*,) a totally different plant.

TIMBER.

PRESERVATIVE AGAINST WOOD SPLITTING.

It is only too well known by those interested in the timber trade that losses amounting to several thousands of pounds annually are incurred owing to the splitting of logs. Felled trees begin to crack and split at their ends after a very short period, thereby rendering useless a good portion of the wood, therefore in calculating the volume of trunks and logs the parts thus affected are always left out of the reckoning. These troubles make themselves obvious, especially in the case of beech, oak and ash wood, which are more than others subject to wood splitting, thus causing extensive losses, which were considered unavoidable because no means were then known to prevent the same.

The cause of wood splitting can be easily explained when one takes into consideration the structure of the timber and its attitude when brought into contact with humidity, Every one knows that thin planks warp as soon as they get dry and expand when affected by the dampness of the atmosphere. As the pores lie principally in the direction of the fibres, it is easily understood that the timber begins to dry up at its ends in the first place, because the open pores which are there give up their moisture very quickly, whereas towards the middle of the timber the moisture remains much longer. Besides this, the air which penetrates the pores to take the place of the moisture oxidises and therefore hardens the sap, which naturally accelerates the drying-up process. Now, as wood shrinks when it dries, it is quite natural for the ends of the timber to contract transversely, and as the middle parts which are still moist cannot follow this pressure, the consequence is that a certain tension is brought about causing the wood to split. From this point of view the firm of Daniel Lorach, of Mulhouse (Alsace), has, after many years' experiments, introduced into commerce a most efficacious means for the prevention of wood splitting under the style of "Preservative against Wood Splitting." The thought that first gave birth to this preparation was to prevent the timber from drying up and decaying; in the second place to prevent the air from penetrating into the pores, thereby presenting a surface proof against all chemical actions of the atmosphere. This preservative surface to be a success must be composed of a substance which is absolutely air-proof, which has no chemical action whatever in the wood, and which offers a great resistance to atmospherical and mechanical attacks of all kinds. The preservative against wood splitting which has just been introduced into the trade by the above-named inventor presents not only these properties, but also the following great advantages:—

It can be applied in the most simple way by means of a brush, drying immediately into a homogenous surface, and at the same time is both elastic and resistable, thus taking the place of the bark.

This preservative can be used just as efficaciously with freshly hewn trees as with planks of all description. If a block of any valuable wood (say £10 worth) measuring 12 feet in length and 2 × 2 ft. in width, is split at both ends to the depth of only 4″ in., the loss amounts to 11s. 1½d. Now, it is claimed that if this preservative is used and both ends are coated with same (which means in this case an outlay of 2½d.) the saving effected on one single log amounts to 10s. 11d. Considering that thousands of logs lose part of their value through splitting at the ends, it is obvious that an enormous economy could be effected.

As this preservative penetrates but very little into the surface of the timber, and as it does not injure the wood in any way, (but on the contrary keeps it in good condition), there are no drawbacks to fear.

This preservative has already been used in manufactories of Agricultural implements, in the construction of mills, in match manufactories, shipbuilding works, forestry works, etc, etc., with the greatest success. We had the opportunity a few days ago of inspecting logs that had been treated by this preservative, and similar wood in its natural state, the former had not a crack in it, whilst the wood that had not undergone the preserving process was split at the ends in all directions.

Our readers can obtain further particulars of the London Agent, Mr. A. W. Christian the Peninsular House, 4, Monument St., E C.—*Timber Trades Journal.*—*Indian Forester*, Vol. XXXIV., No. 2, February, 1908.

PLANT SANITATION.

PRACTICAL REMEDIES FOR INSECT PESTS.

BY H. MAXWELL-LEFROY, M.A., F.Z.S.,

Imperial Entomologist.

The ultimate aim of the study of destructive insects is the discovery of some feasible method, whereby their increase and destructiveness may be checked and crops preserved from their attacks. In such a quest, not only must the habits and characteristics of each individual pest be considered, but it is of equal importance to take into account the conditions under which the crop is grown and the facilities there are for adopting any method of repression. It is probable that in India, the scientific methods that appeal to the skilled farmer of European countries will be of little value when applied to the conditions of Indian Agriculture, and the best methods that science reveals can scarcely be regarded as suitable to the present problem. In very many cases, the habits of a pest are such that practically nothing is possible unless we can utilise the most up-to-date and artificial methods. In others, a weak point can be found in the life of the pest when it can be successfully attacked by some very simple means. Given some such simple remedy, thorough co-operation in its application over some area is usually also necessary, and this is perhaps to be obtained only when an unusual abundance of a pest awakes the ryot to the necessity of some action and, with a little pressure, a fair trial can be given to the remedy. Experience has shown that, for some pests, there are such simple remedies as can be applied by an individual cultivator, and it is chiefly these I propose to discuss here.

An instance that has already been discussed in these pages (Vol. I, p. 58), is the very simple method of checking the stem-borer of cotton, where the withered plants which contain the pest can be removed and burnt with the pest in. The emerging beetle is not a wide-ranging insect and is apt to confine its ravages to a small area; the destruction of the withered plants in a cotton plot does much to protect that particular plot, and though joint action over a large area would be far more effective, even a small plot may be largely protected.

The red bug of cotton is a pest that yields to the simplest of all methods, destruction by hand; so also the very common dusky bug, which often swarms in cotton bolls, can be checked by the simple precaution of removing all the bolls that are worthless at the same time as the round ripe bolls are plucked. It is unfortunately a general practice to leave on the plant those bolls which have been so damaged by bollworm as to be not worth plucking; the dusky bug finds there a secure breeding place where it may lay its eggs, and where its young can obtain food from the uninjured seeds; from these breeding places it spreads to other bolls and in them it sucks the seeds, rendering them useless for sowing or oil-extraction. The removal of all such bolls is a simple and effective means of preventing the feeding of this pest. In cases where dusky bug is very abundant, a further simple method is valuable; the bug collects in the bolls in great numbers and, when disturbed, runs out and falls to the ground. The greater number of these can be destroyed by tapping the boll while a pot of water with a film of kerosene over is held below the boll; practically all the bugs fall into the water and are killed, and an infested field can be very rapidly cleared.

Among the minor pests of cotton that are occasionally very injurious is the leaf roller, a green caterpillar that rolls up the leaf into a funnel and lives inside. This pest commences when the cotton (if sown with the first rain) is about a month old; the rolled up leaf is very characteristic and an infested plant has a peculiar appearance due to the unnatural position of these leaves. Every one of these leaves can be picked off with the caterpillar in, and if the work is done early, the first brood can be so thoroughly checked that very little remains to be done. If the first brood is missed, the increase is so great that a vigorous crop will be completely stripped later in the season, and it then becomes a far harder task. Were labour an expensive item, spraying with an arsenical poison would be the simple remedy, and both have been in use on the Pusa Experimental Farm. As it is, we have here a case that particularly applies to our conditions, one that is within the reach of any cultivator or Zamindar.

A pest that is constantly reported from cane-growing districts is the Moth-borer; this pest was discussed in a previous number of the Journal (page 97, Vol. I, Pt. II.), and the principal remedy for it is to cut out and remove all the shoots which die in the young canes and which

have the insect in them. In many juar-growing districts, especially in the Central Provinces and Bombay Presidency, this hibernates in juar and the caterpillar is constantly found in the stumps left in the ground after the crop is cut. The removal of these stumps is a very valuable remedy, since it removes the pest when it has no other refuge and destroys the insects that would otherwise do much harm later in the season. This is a practical measure well worth impressing on cultivators; they know the insect, they can be shown it in the juar stump, and though they do not understand its transformation, yet they are open to the commonsense suggestion that these insects will increase later on and attack their crop. Most of these remedies are pure commonsense, and if we could find such weak points in the life of every pest, we would be able to deal more effectively with the problem. Apart from their value as remedies, they are valuable also as demonstrations; if a start can be made by demonstrating such simple remedies, and the ryot can be induced to take them up at times when the losses from the pest are fresh in his mind, the foundation for further work in checking preventible loss will be laid. It is astounding how universally the simplest remedies are unthought of by the cultivator, apparently because the question of checking pests never suggests itself until the overwhelming numbers of a caterpillar or grasshopper make a practical remedy an impossibility. In very many cases, if the possibility of checking the insect was known to the ryot, he would, from his own intimate knowledge of his crops, be able to prevent or check much of the loss that constantly occurs.

A case in point is the brinjal crop, a paying vegetable crop grown for long periods on land that can be irrigated, to supply a local market. This plant is destroyed by a caterpillar that tunnels in the stem, and that sooner or later so interferes with the upward flow of sap that the plant suddenly withers; the cultivator then pulls up that plant and, if not too late, puts in a young one from which he may hope to get a small yield. The withered plant he lays somewhere near by, with the borer in; this presently transforms and emerges to lay eggs in large numbers on other plants. Had the cultivator burnt his plants from the very first, plucking them out regularly as they withered, he would have prevented the very large loss in the later growth of the crop, a loss that often means a great reduction in the yield of the field.

Til is a crop from which two pests are very commonly reported; one is a large green caterpillar, with bright oblique stripes on its sides, and a curved horn at the hind end. It grows to a length of three inches and is very conspicuous. The other is a small caterpillar, creamy green, with little black specks, which rolls the leaf and bores in the capsules. Both yield to the same treatment, destruction by hand *when they first commence;* the smaller caterpillar especially is checked by this treatment as its life is short, it multiplies very rapidly and it often is very injurious to the seed capsules as the crop ripens. In this case again, it is cheaper and equally effective to remove by hand as to spray with an arsenical poison.

A familiar pest to cultivators in some parts of India is the common white ant; investigation up to the present shows that the destructive white ant of the plains is one species only; in some parts of the country it nests below ground, in others at the surface or it builds up mounds above the surface of the soil. Where the termites nest deeply as in the deep alluvial soils of the Gangetic and Indus plains, practical means of checking termites are difficult to find; but where they nest at the surface, a great deal can be done to check them by the systematic destruction of the nests; the simplest method is to dig into the nest and pour in abundant boiling water; the sign of success is when the very large white queens are obtained as they are found only in the nest itself, and if these are destroyed with as many of the smaller termites as possible, the termites cannot increase until they build up a new nest and rear a fresh queen. In some parts of India, there is little reason why any termite nest should be allowed to remain, and a little systematic effort by each village would keep the land practically free of this destructive insect.

Another common pest is the weevil whose grub tunnels in sweet potatoes, rendering them wholly unfit for food. We have seen fields, where a crop had been dug, covered with potatoes which were thoroughly infested and left to breed weevils, thus providing a plentiful supply of insects to infest other fields or the next crop. This might readily be avoided if these potatoes were gathered and buried in a pit under a foot of hard trodden soil. It is only pure commonsense to take such a precaution and so prevent the multiplication of the insect to attack next crop.

For some pests the bag and frame so extensively used in the destruction of the hoppers of the Bombay Locust is a practical method. The surface grasshoppers do a very large amount of

damage yearly in the young crops, especially in the germinating *rabi* crops. These are flattened insects, white below, with the upper surface roughened and earthy colour; they abound in the fields and hop up as one walks along. If a wide bag on a frame is run through the field fairly rapidly, the grasshopper, as it jumps up, is caught by the bag and swept up. At the end of each run the bag is twisted up and the insects shaken into a corner and destroyed. In this way a large area can be rapidly and thoroughly cleared, either before the crop is up or while the plants are still young. The cost of a bag and frame is small, as it is all made on the spot and it should not exceed three rupees. In the case of tobacco, it is very necessary to clear the land of the grasshoppers before setting out the plants. In Pusa we dip all such seedlings in Lead Arseniate Wash and so render them immune, but the bag, if used before the plants are set out, has the same effect.

The bag in its various forms is useful in many cases when its application is once understood, and it provides the most practical remedy against a fairly universal pest of rice, the Rice Bug. This is a slender green insect, which flies readily when full grown; it emits the usual aromatic odour of its class and an infested field may often be known by that alone. As the rice comes into ear, the bugs assemble there and suck out the milky juice in the develop-grain. The grain then whitens and the ear has nothing in when it comes to harvest. A light bag, 8 feet wide, run rapidly through the field, brushing the tops of the rice sweeps up these bugs, and though some escape, the bulk are captured. A bag must be used as the insects escape from a plain cloth or *dhotie* unless it is smeared with sticky matter; the bag is considerably more effective if first soaked in kerosene or in an emulsion made by shaking up kerosene with sour milk. This method like the others mentioned above is in application on the Pusa Farm, where ordinary coolie labour is employed; as soon as the bug is found, the bag is used and there is no difficulty in checking this peat.

Rice is constantly attacked by another class of pest, which yields to simple treatment if that treatment is carried out over any area larger than a few acres; this pest is the stem-borer, a caterpillar which eats up the centre of the growing shoot of rice and kills it; the result is that each shoot withers, and as a single caterpillar in many cases attacks several shoots, the damage to the ripening crop is considerable. This form of damage is reported from practically every rice-growing tract in India; several insects are concerned, which are all quick breeders, and of which two or three broods complete their life-history in one crop; for all these there is but one practical cure; that is, to pick them all out from the beginning; if the cultivator would learn that withered rice shoots contain a caterpillar which, if left alone, breeds and multiplies quite naturally, he might systematically pick out and burn all withered shoots; these are sufficiently easy to see, and it does not require much time or labour to go over some acres of paddy. Were this known to the cultivator and were he to do it, we believe that no cases of destruction by these pests would ever be seen. In some cases, it is possible also to utilize another method, depending upon the fact that, like the moth-borer of cane, the stem-borer of rice spends the cold weather or hot weather when the crop is not growing in the stubble; where this stubble can be taken out and destroyed, it destroys those insects which live over until the next crop and then emerge to breed. How far the destruction of rice stubble is possible depends upon local conditions, but it is always a valuable safeguard.

A common and widespread pest is the surface caterpillar, a dark-coloured smooth caterpillar, over one inch long, which lives by day in the soil, emerging at night to wander about and cut off young plants for its food. This insect can be easily collected by hand, its burrows being revealed by the green leaves which it has consumed; as a rule, it lies hidden near the plant it has cut off, often at its base, and it is readily found with the hand hoe (kurpi).

It is perhaps needless to multiply instances of this, the simplest of all methods. For very many pests, the remedy is there to hand, namely, to destroy the insects when they first appear and so to save the later destruction caused by their natural increase. We have cited cases enough to show that, in very many instances, there are simple methods by which the cultivator could materially lessen the losses caused to his crop by insects. It is perhaps needless to say that there are other cases where equally simple remedies could be devised *by the cultivator*, if he knew how his pests lived and multiplied; in most cases, the scientific study of an injurious insect shows what its weak points are, but to take advantage of them requires also a very thorough knowledge of local agriculture which no one person can have for more than a limited area; the treatment of such pests must be a matter

for the future, but there seems to be no reason why efforts should not now be made to bring home to the cultivator the facts regarding such simple pests as it is possible for him to cure, and thereby to open his mind to the realisation of the fact that, the knowledge of the pest's life-history is the first essential, and that, given that, it is often within his scope to devise some means of circumventing the enemy. The cases enumerated above are cited as being those in which there exist a simple practical remedy for a particular pest; if the cultivator can be induced to adopt one of these and so to lessen the damage to his crop in any one case, a great step forward will have been made.—*The Agricultural Journal of India*, Vol. II. Part IV.

TO DESTROY THE NESTS OF TERMITES (WHITE ANTS).

A very useful machine, sold under the name of the 'Universal' Ant Exterminator, has been employed in the Royal Botanic Gardens, for the above purposes, with complete success.

The machine consists of a small charcoal furnace in connection with an air-pump. Some glowing charcoal is placed in the furnace; a spoonful of the mixture (composed of White Arsenic 85 per cent. and Sulphur 15 per cent.) is thrown on to the charcoal and the lid firmly clamped into position. A flexible nozzle is pushed into the main entrance of the nest, and all supplementary holes are plugged with clay. The pump is then worked and drives the vapour into the nests, forcing it into all the ramifications of the galleries. Little jets of smoke will soon arise from crevices and unsuspected openings for several yards round the main entrance. These should be immediately stopped with clay or pounded earth. After a few minutes of vigorous pumping, the nozzle may be withdrawn and the hole plugged with clay. The nest should remain undisturbed for a week, when the mound may be levelled. If opened immediately after the application, some of the insects will revive. In some few cases there may be feeble signs of renewed activity, in which case a second application will complete the work of destruction; but this is seldom necessary.

The machine is at present obtainable only from the Natal Agents (Messrs. P. Henwood, Son, Soulter & Co., of Durban) and costs in Ceylon (inclusive of transport) £4-12-6.

E. ERNEST GREEN.

[A Circular, dealing with white ants generally, will shortly appear.—ED.]

SCIENTIFIC AGRICULTURE.

EXPERIMENTS WITH CALCIUM CYANAMIDE.

By A. D. HALL, M.A.

The nature of calcium cyanamide, the new nitrogenous fertiliser manufactured by combining the free nitrogen of the atmosphere with calcium carbide, is now well known (see Journal, 1906, Vol. 13, pp. 38, 216, 410); and numerous field experiments both in this country and abroad, have established the fact that as a manure it is practically as effective, nitrogen for nitrogen, as sulphate of ammonia. Certain practical difficulties in its use have, however, been pointed out; it is sold in so fine a powder that it is difficult to handle and disagreeable to sow. It was regarded as so liable to change in a damp atmosphere as to be dangerous to store, and when first introduced it was recommended that it should never be mixed with other manures but sown separately a week or ten days before the seed. In view of the fact that the manufacture is now being undertaken on a large scale, and that certain improvements have been effected in the process, it seemed necessary to re-examine the manure from these points of view; its efficiency as a fertiliser being no longer in doubt.

The questions that seemed to require investigation were as follows :—

(1) How far is the material hygroscopic, so that it cannot well be stored under ordinary conditions in bags in a manure store or shed?

We are not concerned with its storage on a large scale by the manufacturer or the merchant, bnt with the way it would affect a farmer who might have a stock on hand for a month or two before using, but who had no special means of keeping it in a dry atmosphere. Assuming further that some moisture will be absorbed, is any loss of fertilising material brought about thereby?

(2) Sincé calcium cyanamide is made from calcium carbide, which by the action of water gives off inflammable acetylene, is there any danger of the generation of this or other dangerous gases from unchanged carbide remaining in the manure, wheu it is stored and exposed to damp air?

(3) Can the cyanamide be safely mixed with other manures, particularly superphosphate, or is there a generation of heat or gases to a dangerous or inconvenient extent? At the same time does either the cyanamide or the superphosphate suffer any loss of fertilising value?

At the outset it should be borne in mind that calcium cyanamide is slowly attacked by water or by moist air and is converted into ammonia and calcium carbonate, roughly in accordance with the equation=

$$CaCN_2 + 3H^2O = CaCO_3 + 2NH_3.$$

There is, however, in the commercial fertiliser a considerable amount of quicklime, which absorbs water and becomes slaked lime in the usual way; this slaking of the free lime being the first action that takes place when the crude cyanamide is exposed to moisture. Once the cyanamide has been decomposed there is nothing that will retain the ammonia produced except any excess of moisture that may be present, hence there is always a possibility of loss of the valuable part of the manure, the ammonia, if it is exposed too long to the air; in the soil the ammonia would, of course, be immediately absorbed by the humus or the clay.

The action of the acids upon the crude cyanamide is similar; a compound of the acid with the quicklime is at once produced with considerable evolution of heat, then the cyanamide is attacked to form compounds of lime and ammonia with the acid in question.

Experimental.—A quantity of calcium cyanamide was supplied to the Rothamsted Experimental Station by the North-Western Cyanamide Company, who are establishing large works in Norway for the manufacture and supply of the manure to north-western Europe. The sample in question came from the works at Piano d'Orte in Italy, where the process is now being carried out in a large scale. It contained, as a mean of several analyses, 17·24 per cent. of nitrogen and was the usual fine black powder, which had been treated by some special process before export, in order to render it less hygroscopic and easier to handle.

(1) ABSORPTION OF WATER, &c., ON EXPOSURE.—A series of small quantities (1gram) of cyanamide was weighed out on watch glasses and placed under a large bell jar over water, thus ensuring the maximum exposure of a thin layer of the manure to the action of moist air. At weekly intervals two watch glasses were withdrawn, and one was weighed in the wet condition and the second dried in the steam oven. The nitrogen

in each sample was then determined and the results are set out in the following table :—

Time of Exposure	Undried. Weight.	Undried. Nitrogen per cent on Original Weight.	Dried. Weight.	Dried. Nitrogen per cent on Original Weight.
	Gram.		Gram.	
Starting ...	1·000	17·24	..	...
After 1 week ...	1·669	16·87	1·231	16·01
„ 2 weeks ...	1·734	16·30	1·240	15·88
„ 3 „ ...	1·793	16·18	1·259	15·26
„ 4 „ ..	1·859	15 97	1·269	15·77
„ 5 „ ...	2·234	15·85	1·289	15·89
„ 6 „ ...	2·069	16·17	1·278	...
„ 7 „ ..	2·431	16·24	1·298	15·13
„ 8 „ ..	2·508	16·21	1·295	14·92
„ 9 „ ...	2·802	15·75	1·296	14·52
„ 10 „ ...	3·235	16·03	1·396	14·69

These results show that the first action of slaking the free lime in the crude cyanamide takes place very quickly when the material is exposed in a thin layer to an atmosphere saturated with moisture since the weight risés 67 per cent. in the wet condition and 23 per cent. in the dry condition during the first week's exposure. At the same time there is a slight loss of ammonia, though this loss is almost covered by the experimental error inherent in drawing small samples from a powder of variable composition like cyanamide, the difference being little greater than that found between consecutive samples drawn for analysis from the original manure.

With further exposure the cyanamide continues to absorb water until in the end it runs down to a wet paste; further losses of ammonia in the wet state, are, however, small, being in the final sample only 7 per cent. of the total nitrogen with which the material started. The weight after drying increases but little in the latter part of the experiment, because the main reaction causing an increase of weight—the slaking of the free lime—is completed in the first week. The losses of nitrogen in the dried sample increase steadily and amount to about 2 per cent. after the tenth week. These losses are due to the volatilisation during the drying of any ammonium carbonate that has formed.

Other experiments on these lines were made, in which the exposed cyanamide was dried in a current of air that was afterwards passed through acid to absorb any ammonia volatilised; they confirm the results set out above and show that the action in the first week is almost wholly a slaking of the free lime attended by a slight production of ammonia which is only volatilised as long as the material remains dry. After the slaking is complete the material begins to get damp and may form a cake; in these later stages larger quantities of free ammonia are produced but only volatilised on drying.

It shonld be borne in mind that these are extreme cases and that changes of the magnitude of those taking place in the first week would only occur in a manure store after a long time, so slowly would mositure reach the material inside the bags. It is wellknown that ground quicklime itself can be stored in bags for some time without serious change. To determine the extent of the change taking place in practice, bags containing 56 lb. each of cyanamide sulphate of ammonia and nitrate of soda were placed on the floor of the manure shed on 1st August and weighed again on 24th August and October.

	Aug. 1st.	Aug. 24th.	Oct. 14th.
	lbs.	lbs.	lbs.
Cyanamide ...	6 ...	57¾ ...	58¾
Sulphate of ammonia	56 ...	56¾ ...	57¾
Nitrate of soda ...	56 ...	55¾ ...	54¼

On 24th August the cyanamide was powdery and in good condition, by 14th October one corner of the bag had burst owing to swelling from the slaking of the lime; the total gain of weight, however, is only 2¾ lb., or about 5 per cent. Now as under conditions of maximum exposure and complete slaking a gain of 67 per cent. of moisture had only been attended by a loss of 0·67 per cent. of nitrogen, the loss of ammonia when cyanamide had been stored in a bag and had only gained 5 per cent. in weight would be imperceptible, since we may assume that the loss will be in proportion to the extent of slaking. That the atmosphere of the manure shed had been damp is shown from the fact that the sulphate of ammonia had also gained in weight and caked a little, while the bag of nitrate of soda had become soaking wet, so that the floor beneath was saturated and a considerable loss of material took place.

It may be concluded that while calcium cyanamide will gradually slake and swell, and suffer a small loss of ammonia on exposure to damp air in bags, yet under ordinary working conditions these losses will be inappreciable, and the manure is no more difficult to store than other artificical manures used by the farmer.

(2) The manufacturers state that they now take special precantions to leave no

unaltered carbide in their product, so that the evolution of acetylene from the cyanamide which was noticed with some of the earlier products no longer takes place.

To test the point a current of air saturated with moisture by bubbling through water was led over 20 grams of cyanamide in a flat-bottomed flask and then through a washing bottle containing a solution of ammonical silver nitrate of known strength. Blackening of the silver solution slowly took place, and after the air current had been continued for seven days the solution was examined. A very small amount of black precipitate was recovered, and this on testing proved to contain silver acetylide, silver sulphide and a trace of phosphide; the amount recovered was, however, too small for analysis. Assuming that it had been precipitated by acetylene and calculating from its weight back to calcium carbide the original crude cyanamide contained:—

Experiment 1.—0·048 per cent. calcium carbide.
2.—0·062 ,, ,,

quantities which are negligible.

In another experiment 20 grams of cyanamide were shaken into a large bottle with a little water, and the bottle stoppered and put aside for a day in a warm place. The bottle was then carefully opened and a light introduced; the taper burnt quietly because not enough inflammable gas had been generated to produce an explosive mixture. Since the exposure in both the above experiments was much more severe than could obtain in practice, it may safely be concluded that the traces of acetylene, sulphuretted hydrogen and phosphine that will be obtained from the crude cyanamide can be neglected, for they will never become a source of danger or even inconvenience. The sulphate and phosphide detected doubtless arise from traces of sulphate present in the limestone originally employed in the manufacture of the carbide.

(3) In testing the effect of mixing cyanamide with other manures superphosphate alone need be considered; it is the only manure containing free acid in quantity (dissolved bones being merely a form of superphosphate), so that with it the maximum of chemical action would take place. Only the water contained in other manures would react with the free lime of the cyanamide; further, it is with superphosphate that mixtures would most usually be wanted in practice.

An ordinary commercial grade of superphosphate was used, and three separate lots, each of 2 cwts. were mixed with 11, 22 and 44 lb. of cyanamide respectively. The mixing was done on the stone floor of a manure shed; the manures were weighed out, a layer of superphosphate was spread on the floor and a shovelful of the cyanamide sprinkled over it, then another layer of superphosphate and another shovelful of cyanamide until the whole was mixed. The heap was then broken down, passed through a sieve, the lumps reduced, and the mixing and formation of the heap were repeated four times to secure complete incorporation of the two manures. The heap was then made up, thermometers were put up into it and read from time to time; finally, on the next day, the mixture was weighed and put up into bags, which were left in the manure shed and examined at intervals. The mixing was a disagreeable operation because of the light powdery nature of the cyanamide, which filled the air and hung about as a cloud for a long time; it was, however, during the weighing out and the first adding of the cyanamide that this occurred, for as soon as it came in contact with the superphosphate no further dust arose during the rest of the process.

During mixing the heap began to get warm, and with the larger proportions of cyanamide began to steam a little; no offensive gases were, however, given off, so that it was only the first dustiness caused by moving the original cyanamide that caused inconvenience or unpleasantness.

As will be seen from the temperature records a considerable development of heat followed the mixing, due in the main to the slaking of the free lime in the cyanamide and its reaction with the acid calcium phosphate; the temperature was, however, kept down by the evaporation of the surplus water in the superphosphate and might have been still further reduced, had it been thought desirable, by sprinkling a little water over the mass while the mixing was going on.

To test this point a further experiment was tried in which two separate hundredweights of superphosphate were spread on the floor and 56 lb. of cyanamide was carefully poured on each, covered with the superphosphate and mixed as before. In one case, No. 4, nothing was added to the mixture of two parts superphosphate and one cyanamide, but in the other, No. 5, two gallons of water were sprinkled on from a water pot as the mixing went on. This kept the dust down entirely, so that it was possible to complete the mixing without any trouble from the fineness of the cyanamide. The highest temperature reached was

95° (it was a damp cool day with an air temperature of 13° C), and the wetted heap ran up to this point more quickly than the unsprinkled heap. This was because 1 cwt. of superphosphate does not contain water enough to slake all the lime in ½ cwt. of cyanamide, so that the mixture did not react as strongly as one poorer in cyanamide would have done. Further, with such a small proportion of superphosphate there was not enough acid in it to neutralise all the ammonia produced, consequently a little ammonia could be detected escaping from the steaming heaps both by the nose and by litmus paper.

These latter trials are quoted here to show that sprinkling with water can be used with advantage while making up a mixture of superphosphate and cyanamide, as it keeps down the dust and restricts the rise of temperature without adding any difficulties to the mixing process or causing the final product to cake or set in any way. In the above experiments the material was friable and in a good working condition on the following day.

As will be seen from the weights the heat generated caused the evaporation of a good deal of water, so that the heaps had lost weight considerably when they come to be bagged. There was no tendency to cake shown during the mixing, and on the following day, when the heaps had cooled down, the mixture was still perfectly loose and friable, neither has it caked at all after lying up in bag for two months and a half. The various mixtures are all light friable powders, rather drier than the original superphosphate and in perfect condition for sowing by hand or drill.

Experiment.	Mixture in lb.		Temperature, C.		Loss of Weight, lb.	
	Cyanamide.	Superphosphate.	Starting.	Maximum in heap.	After Mixing.	After Storage.
No. 1	11	224	16·5	53	5	12
,, 2	22	224	18	87†	5	12
,, 3	44	224	18	110‡	28	29
,, 4	56	112	13	95§	3	—
,, 5	56	112*	13	93 ‖	5	—

Samples were taken from the first three mixtures and analysed with the following results, in which comparison is made between the figures obtained by analysis and the figures calculated on the assumption that no loss of fertilising material had taken place, after due allowance had been made for the shrinkage in weight due to the loss of water on mixing.

* Also 20 lb. water. † After 6 hours. ‡ After 11 hours. § After 2½ hours. ‖ After 1 hour.

	Nitrogen.		Phosphoric Acid.		
				Citric Acid Soluble.	
	Calculated.	Found.	Water soluble (found).	Calculated.	Found.
Cyanamide ...	—	17·24	—	—	—
Superphosphate	—	—	11·48	—	12·68
Mixture I ...	0·864	0·852	6·66	12·35	11·65
,, II ...	1·540	1·630	1·65	12·14	11·22
,, III ...	3·080	3·054	—	11·88	10·57

Allowing for the errors introduced by mixing and sampling, these results are quite consistent and lead to the following conclusions:—

(1) There is no loss of nitrogen; any ammonia that is generated on the slaking of the lime is at once fixed by the superphosphate. This conclusion is confirmed by the observation that not the least smell of ammonia could be detected during mixing or arising from the heap after mixture, except in mixtures 4 and 5 where an excess of cyanamide was used.

(2) The water soluble phosphoric acid in the superphosphate is rendered insoluble in proportion to the amount of cyanamide introduced. As would be expected, the free lime of the cyanamide combines with the soluble calcium phosphate in the superphosphate to form a calcium phosphate insoluble in water. A mixture of one part cyanamide to ten parts superphosphate precipitates most of the soluble phosphate, when the mixture is raised to 1 to 5 all the soluble phosphate has been converted into dicalcium phosphate.

(3) The amount of citric acid soluble phosphate (determined by the official method of shaking for half an hour with 2 per cent. citric acid solution* under-

* The citric acid solution is used to discriminate between phosphates which are readily soluble in soil water, such phosphates as are found in basic slag or basic superphosphate or are produced in the soil by the application of superphosphate, and on the other hand, the unchanged phosphate of lime which is practically insoluble in the citric acid.

goes little change from the mixing. Evidently the reaction between the slaked lime from the cyanamide and the soluble phosphate gives rise to di-calcium phosphate, the usual precipitated or "reverted" phosphate which is completely soluble in citric acid solution. Very little change to tricalcium phosphate is brought about either by lime or the heating.

From the fertiliser point of view, then, the mixture of cyanamide with superphosphate occasions no loss of nitrogen, but more or less of the phosphoric acid ceases to be water soluble, remaining, however, as the readily available dicalcium phosphate. While the precipitated phosphate cannot be regarded as of quite the same value as water soluble phosphate, the falling-off in fertilising value is slight.

Various attempts were made to ascertain how much of the nitrogen of the original cyanamide had been converted into ammonium salts in the mixed manures; the results were, however, unsatisfactory owing to the fact that the unchanged cyanamide is itself continuously decomposed when distilled with magnesia. They indicated, however, that little formation of ammonium salts had taken place.

Some experiments were also made to see if any quantity of the dicyanodamide, which is said to be poisonous to plants, had been produced in the mixture. Six pots were made up, each containing about 3 kilos. of sand, and, in addition to potassium sulphate and other nutrient salts, 0·3,3 and 6 grams respectively of mixture No. 3 were added to the pots with an appropriate amount of water, and young barley plants were planted in each pot. The experiment was started too late in the year to be pushed to a conclusion, but in all cases the barley grew, though not very freely where 6 grams (=0·2 per cent. of the whole contents of the pot) had been added. However, such an amount is excessive in a sand culture, and the mere fact that the barley grew for three months in contact with so large a proportion is evidence that nothing that would be poisonous to plant life in practice had been formed in the mixture.

From our experience in making up these mixtures I should be strongly inclined to recommend farmers using cyanamide to mix it before sowing; it will mostly require to be used with a phosphate, and it is much less trouble to mix cyanamide with superphosphate in a manure shed than to deal with it in the open. It would be practically impossible to sow cyanamide by hand, and even a machine would result in great waste and unpleasantness to the men except on the stillest of days; but after the first spreading of the cyanamide on the floor is over, mixing with superphosphate presents no further inconveniences, and the resulting mixture is easy to handle and can be dealt with like any other artificial manure without even the waiting period before seeding that is recommended when cyanamide is sown alone.

The net conclusions from the above experiments are that calcium cyanamide as now manufactured can be stored for a reasonale time under ordinary conditions without danger or sensible loss of its fertilising properties; cyanamide can also be mixed without difficulty or loss with superphosphate, the resulting mixture being as easily handled as any other artificial manure.—*Journal of the Board of Agriculture*, Vol. XIV, No. 11, February, 1908.

[Experiments with this new fertiliser, which is already stocked by at least two firms in Ceylon, are now in progress.—ED.]

SOIL CHEMISTRY.

A good deal of improvement work is being done in this line in America. Recent investigations by Osterhout and others (of *Bot. Gazette*, 45, February, 1908, p. 117) go to show that "magnesium salts and potassium salts, used separately, are poisonous to plants, but when mixed together (in suitable proportions) the poisonous effects more or less completely disappear." It is to be noted that these poisonous effects only show markedly when the solutions are comparatively concentrated, and that both potassium and magnesium are essential constituents of the food of plants.

LIVE STOCK.

ABSCONDING SWARMS OF BEES.

By R. Beuhne,
President, Victoria Apiarists' Association.

The absconding of swarms is a source of annoyance to the beekeeper at any time; and, during, or just before, a honey flow it is a serious loss.

There are quite a number of causes which induce bees, after swarming and hiving, to swarm out once more and depart. Occasionally it may also happen that a swarm will issue from a hive and fly straight away without first, as swarms usually do, settling in a cluster on some object not very far from the hive. A swarm which absconds without first settling is nearly always from a hive which by some means has lost its laying queen, and the queen which accompanies the swarm is a virgin queen raised from the brood which was left when the old queen died or failed. As it takes sixteen days from the egg to the emerging of the queen, and a few more days before the young queen is ready to take wing, very little, if any, brood will be left when she takes her mating flight, which is about five days after hatching. As she leaves the hive the bees follow as a swarm and usually depart with her. It is of course impossible to entirely prevent this kind of absconding, for every hive cannot be examined often enough to discover the loss of a queen, but whenever a colony is found in which the presence of queen cells and the absence of eggs indicate queenlessness, all the queen cells except one of the best developed should be destroyed. After the young queen has emerged, one, two or three combs (according to the strength of the colony) of eggs and young larvæ from other colonies able to spare such, should be given. The presence of this young brood will hold the bees, that is, prevent them going with the queen when she leaves the hive for the purpose of mating.

This practice of breaking out surplus queen cells and giving young brood after the only remaining cell has hatched is also the best way of preventing the issue of after-swarms from hives which have thrown a first or prime swarm, and from which further swarms are not desired.

In the case of ordinary box hives, which owing to the absence of frames cannot be dealt within the way described, the same object may be attained, but with less certainty, by placing the newly-hived first swarm on the spot occupied by the old box after having removed the latter to a new stand. This causes most of the old bees which still remained in the parent hive when the swarm issued, to join the swarm because it occupies the spot to which they fly when returning from the fields. Thus only bees which have never yet been flying out remain in the parent hive which in consequence is not able to cast another swarm when the first of the queen cells hatches. The first emerging queen is therefore allowed by the bees to destroy the remaining queen cells. When a colony swarms before any queen cells are sealed, and there is much brood in the hive, sufficient bees will have become of field age during the extra length of time which must elapse before the first queen hatches, to bring the colony to swarming strength, and a second swarm may result notwithstanding the removal of the colony to a new stand when the first swarm issued.

Much of the absconding of swarms which issue in a normal season could be prevented by the owner of the bees if he were aware of the causes which bring it about. One cause is leaving the swarm too long before hiving it. A normal swarm usually settles somewhere not far from the old hive. After an hour or so scouts go out looking for a place to found a new home, and after such has been found the swarm will often persist in turning out after hiving and perhaps finally absconding to the place selected. Other causes of swarms refusing to stay when hived are excessive heat, want of ventilation, annoyance from ants or robber bees, or an objectional odour of the box, that of kerosene, for instance.

The bees of a swarm are in a state of excitement, and the box in which they are hived should be well shaded and given a large entrance for three or four days. It should also be free from odours or stickiness of honey, which would attract ants or robbers.

Turned out swarms are more troublesome than swarms issuing for the first time. In the latter case the bees are gorged with honey and therefore heavy; they settle low and are seldom inclined to sting. On the other hand bees swarming out of an empty hive after having consumed the honey they carried are light on the wing, often settle in inaccessible places, sting more readily, and frequently abscond.—*Journal of the Department of Agriculture of Victoria*, Vol. VI., Part. 3, 9th March, 1908.

APICULTURE IN CEYLON.

(2nd Series.)

BY AN AMATEUR.

(Concluded from page 262.)

IV.

The question of the sale of honey is naturally one of importance; and I propose to deal with this shortly, together with a few suggestions on the subject of bee-forage. One is apt to imagine that it is possible to keep an unlimited number of hives within a fixed radius without detriment to the amount of honey secured by individual hives. There are, I believe, eight bee-masters in the United States that own more than a thousand hives in their particular locality, which seems to bear out the supposition. But it must be recollected that these grandees live in districts abounding in honey-producing plants, and they never lose an opportunity of increasing the amount of bee-forage in their neighbourhood, Thus, certain parts of the Northern States contain whole forests of linden-trees, which probably yield ten times as much honey as any other kind of tree in existence. And again, California boasts thousands of acres of such arid land, that nothing will grow there but the famous sage-scrub—a honey-producer of the very first rank. And bee-keepers in these districts will generally distribute to neighbouring farmers seed of other nectar-yielding plants free, on the understanding that the farmers shall sow up great tracts of arable land with these seeds. And those of us that know the Scottish moors and have heard the huge areas of heather humming with millions of bees will hardly be surprised to learn that such districts will support an almost unlimited number of hives.

But in most districts the case is otherwise. A certain number of hives can be kept with profit; but beyond this number the average weight of honey per hive decreases. It is, therefore, all-important to find out what plants and trees in the apiculturalist's environs yield honey, at what seasons they are in flower, and what number of hives can be kept in a certain area. When this is known, then the bee-keeper can set to work, and by judicious planting increase the honey-yield of his neighbourhood. Some jungle-trees he will find to be absolute non-producers of nectar, while others, at certain seasons, positively hum with bee-life. He should, therefore, endeavour to spread the latter at the expense of the former. Huge areas of the hill country will permit the growth of European plants. Mustard we know will grow well there; and twenty acres of this will yield a very nice crop of honey, and later on a further crop of seed, which always has a market value. The same applies to rape. White clover and alsike (*Trifolium hybridum*) afford the very finest cattle fodder, while their nectar fetches a very high price on the European markets. Then, again, we know that gorse grows freely above 5,000 feet; and I am convinced that great tracts of the ugly and comparatively useless patana-grass could be gradually replaced by heather, which is a valuable sheep-fodder. I can fancy the Horton Plains, for instance, not only made immensely valuable, but also considerably beautified by the introduction of heather—and the experiment could be tried there of turning down grouse and thereby increasing the value of Ceylon as a sportsman's country!

The famous buckwheat would almost certainly thrive and yield a double profit in honey and grain in the hill country. And I suppose every English lady out here has a little mint in her garden. The native mint appears to bear no flowers; but the English variety flowers well and yields a delicious nectar—besides having a more delicate flavour. The ordinary thyme should be replaced by the larger variety found in Southern Europe, or by the large-flowered and intensely sweet marjoram. Ugly and dry patches of gardens can be filled in with the graceful shrubs of rosemary. Hedges of the glorious New Zealand fuchsia can take the place of the uninteresting Madras thorn, yielding an almost endless supply of flowers for table-decoration; and an unsightly corner of the garden can be filled with borage, which flowers unceasingly for three months together.

But in addition to nectar-yielding plants, an eye should be given to those yielding pollen. Mignonette, Job's Tears, sunflowers, schizanthus, poppies, tree-tomatoes, Cape gooseberries, and various grasses will be found of value. And all the citrus family yield pollen as well as honey in great store. If it is desired to plant shade trees along roads, why not put in oranges, lime, pomeloes, &c, ? We know that these do well between 2,000 and 5.000 feet. Below that we could put in some of the sweet-scented trees so abundant in the streets of Kandy and Colombo; and above that elevation we have the handsome and valuable golden wattle. The blue-gum gives a honey of peculiar, but not unpleasing, flavour, valuable for the antiseptic properties contained in it. Passion-fruit and its allies, and cherries,

apples, pears, &c., not only contain a valuable nectar, but also produce double the crop of fruit when bees are kept near them. Strawberries, also, though producing very little honey, yield pollen and bear heavier crops in presence of hives.

There is a strange superstition current in lay circles that "half the honey one buys is manufactured." I have myself often heard it amplified somewhat on these lines :—

"Do you mean to say you have never heard that there are factories in Switzerland where you can actually see machines at work pressing paraffine-wax into the shape of cells and pouring syrup in? Why, it is no secret at all!"

If you ask Mr. Know-all if he has ever witnessed the process, he will invariably reply that he has not; but that he knows "dozens of men that have." Needless to say, Mr. Know-all conveniently forgets to send you the names and addresses of his friends, which he "has written down somewhere in an address-book." It is a great pity that these friends can never be traced, as they have seen things that no scientist has ever been able to discover.

The fact is, Mr. Know-all likes to pose as a well of useful information. He has probably heard the assertion made by an ignorant nurse, when he was a little boy, and thinks it may be a useful piece of knowledge to air to his credulous friends. So far is it from being the truth that, if he can name the factory in question, he can claim a very large reward (£400, I think), offered by a syndicate of large bee-keepers in order to disprove the lie! The reward has been offered and advertised for several years now. Is it not a little strange that some of the dozens of friends of Mr. Know-all have not claimed it yet?

No. You may make up your mind to it that all comb-honey is genuine, and that quite 95% of run-honey is likewise pure. There are, and always will be, dishonest traders that will adulterate run-honey with some cheap syrup; but it is the exception. So you can safely challenge Mr. Know-all when next you meet him. It will doubtless afford you some considerable satisfaction to be able to take him down a peg or two—which is always beneficial to his kind.

It is easy to see how this curious superstition has arisen. An ignorant man has seen a bee-keeper introduce a frame of foundation to his hive. It is neatly stamped to the shape of the base of cells. Therefore it is artificial. He does not trouble to discover that, if the bee-keeper used any other wax but the purest beeswax, it would melt in the heat of the hive and kill his bees. Again, he sees the bee-keeper feed syrup to his bees. Of course, the bee-keeper has bought sugar at 2d. and will sell the resulting "honey" at 6d. The whole matter is as clear as day. He does not, unfortunately, take the trouble to discover that the bee-keeper only does this in order to build up weak colonies or to give a stock sufficient stores of food to tide it over the winter! Feeding is always somewhat of a messy job; and you may lay to it that the bee-keeper is not going to do more in that line than he is obliged!

It is just as well to do what you can towards dissipating these absurd beliefs, since people do not like to think they are being swindled; and if they know that you sell only pure honey, they will like to buy from you, and so you will command a market. With this object in view, therefore, you should ask your friends to come and see your bees—take out a frame and point out which cells contain honey and which brood; draw their attention to the queen—the rabble always enjoys a glimpse of royalty! Explain to them the use of foundation and show them a piece. Describe how and why exactly you feed your bees. And I may add that, if you can handle your bees without using a veil, they will be far more interested, believing that you must necessarily understand a tremendous lot about the creatures!

Your next object should be to place your honey on the market in an attractive form. Owing to the absence of competition in comb-honey, you will do best at first to deal as much as possible in that. All sections that are well-filled and capped up to the edges, with nice level surfaces, clean and white in colour, should be graded as first-class. Then you can establish a criterion for second-class sections; and all that falls below that standard should be extracted or left in the hive as Monsoon stores for the bees. If, however, you find that the bees bring in a nice-tasting honey that is not pure white—heather and buckwheat, for instance, yield a nectar that is distinctly yellow—do not put this in the second-class, but grade it first-class as dark honey. I need hardly remind you that heather-honey is as great a favourite at home, and fetches as big prices, as white clover honey. Be careful not to leave the sections on too long, or they will lose their pristine whiteness, owing to the perambulations of countless bees over their surfaces.

In order to extract honey from combs or sections, you must have an uncapping-knife to shave off the caps of the cells, and a centrifugal extracting machine, which costs from 14s. to about £2. It is as well, however, to remember that honey gathered from heather or buckwheat is too thick to extract by means of a machine. The extractor is also frequently used to empty a brood-comb of honey when the bees are filling cells too quickly in the brood-nest and thereby leaving the queen no room to lay her eggs.

When you come to your honey-harvest, you will require a sheet of queen-excluding zinc for each hive. This is laid above the brood-nest and prevents the queen going up into the super to lay eggs there, while the perforations are sufficiently large to permit easy passage to workers. These cost about 10d. to 1s. each in England. And when you come to remove racks of sections from your hives, you will find a super-clearer (costing about 2s. each) very useful. It is a board which is slipped under the super and allows the bees already in it to go down into the body-box, but prevents any bees returning into the super. Twenty-four hours after putting it on, you will find not a bee among your sections.

When extracting from sections, remember to put back the empty sections as soon as possible into the hive for the bees to refill. They will do this in a few days, as they have no need to spend any time or energy over building new combs.

All cappings shaved from cells, and, in fact, every scrap of waste wax should be carefully collected and melted down, either in a solar wax-melter (costing about 15s., which gives the whitest wax), or in an old fish-kettle, placing the wax on the upper (perforated) surface and filling the lower part with water. The kettle is placed over the fire and allowed to boil, when the wax falls through into the water and, when cold, forms a thick crust on its surface. Wax—pure beeswax, that is—always commands and always will command a large market and high prices; and the bee-keeper will find a small supply very useful to have near him, as he will frequently require it to fix starters of foundation to frames.

Extracted honey should be put up in ½ lb. or 1 lb. bottles—procurable from any bee-dealer at about 11 to 16 shillings per gross, the more expensive ones being screw-capped—and labelled attractively with your name. Sections should be packed in little cardboard boxes (costing about 4 to 12 shillings per hundred, accordingly as they have glass sides or not) and likewise labelled. All bee-dealers make a specialty of supplying labels printed in colours—generally with a picture of a bee-hive or a spray of flowers—with the words: "Pure honey from the Apiary of———." They cost about seven shillings per thousand—or possibly even cheaper. If they attract even one customer or induce a customer to pay one cent. per lb. more for the honey, you are well repaid!

Agricultural shows are frequent in all parts of the Island. You should utilise these for the purpose of advertising your wares. Have a nice exhibit of sections and bottles of your honey, and make up your mind to give away fifty sections as presents. At one end of the show-ground (where the public will not be disturbed) exhibit a hive of bees—if possible an observatory-hive—and handle them from time to time for the public to see. If you put up a notice that you would handle them at 11 a.m. and 4 p.m., and that you would give notice by ringing a bell, you would have a seething crowd round you every time. You may ask what attracts them. What attracts a crowd when a man advertises his intention of entering a cage of lions? They hope, of course, to see you stung—and they will be disappointed, for the bees will be so confused by the crowd of people that they will be harmless!

I shall now bring my papers to an end. I have not told you much, but the rest you will quickly learn by experience. I will therefore wish all that have followed my remarks with a view to starting apiculture every success and a pleasant addition to their breakfast-tables and their incomes.

VETERINARY NOTES.

Foot-and-Mouth Disease.

In view of the outbreak of foot-and-mouth disease in Edinburgh, referred to in my last contribution, the *British Medical Journal* of the 14th March, 1908, contains some interesting facts about the disease.

2. Three German Veterinary Surgeons, it is said, made the experiment of drinking daily about a quart of milk obtained from cows affected with this disease.

3. On the second day of the experiment one of the men manifested fever, headache and itching of the hands and fingers. Five days later a vesicular eruption was seen in the mucous membrane of his tongue, cheeks and lips and on the skin of his hands and fingers.

4. The other two experimenters also contracted the disease, but in their case the eruptions were confined to the mouth.

5. The precise nature of the virus of foot-and-mouth disease has not yet been elucidated. Some years ago various bacteria were isolated from the lesions and the blood of the affected animals, and each bacterium was claimed by its respective discoverer as the causal agent; but it has recently been shown that the liquid contents of the vesicles of this disease retain their virulence after large dilution with water and passage through a filter, the pores of which are so minute as to prevent the transmission of the smallest known bacteria. It is, therefore, probable that the true causal agent is not within the range of the existing powers of microscopic vision.

Tuberculosis.

6. Another disease communicable to man from the lower animals is Tuberculosis. It is caused by the tubercle bacillus which was discovered by Koch. The relation between human and bovine tuberculosis is a subject of vital importance. But it is strange that there has recently been a good deal of difference of opinion regarding it.

7. Koch himself held the opinion that human tuberculosis was entirely different from bovine, and could not be transmitted to cattle, and that the infection of human beings from bovine tuberculosis rarely occurred, if ever.

8. On the other hand, there are experts who believe in the essential identity of both types of the disease, and say that there is only one tubercle bacillus, and that its pathogenic properties are determined by its habitat and by the tissues and fluids in which it has developed.

9. Dr. Nathan Raw, an eminent specialist, holds an opinion which may be called the mean between these two extremes. He says that the bacillus of human tuberculosis and that of the bovine disease are different varieties of a common species, and that bovine tuberculosis is frequently communicated to human beings both by means of infected food and by contagion.

10. As to the particular lesions in the human body produced by these two varieties of the tubercule microbe, he thinks it probable that phthisis pulmonalis and ulceration of the intestines and abdominal glands are produced by the bacillus of the human type and tubercular peritonits, tuberculosis of the lymphatic glands, tubercular meningitis and lupus by the bovine bacillus.

11. When there is such a divergence of opinion, it is best to err on the side of prudence with regard to the sanitary measures adopted for the prevention of the disease; and the recent Royal Commission on Human and Animal Tuberculosis, after numerous experiments and exhaustive examinations of the lesions, have come to the conclusion that the tuberculosis set up by the bacillus of human source is, so far as its anatomical and histological features are concerned, one and the same as the tuberculosis set up by the bacillus of the bovine source.

12. They have further arrived at the conclusion that cattle and man can be reciprocally infected, and urge the necessity of more stringent measures being enforced to prevent the sale and consumption of milk from cows affected with tuberculosis.

E. T. HOOLE,
Acting Govt. Veterinary Surgeon.

MISCELLANEOUS.

CAMPHOR CULTIVATION IN CEYLON.

(*Illustrated.*)

BY H. F. MACMILLAN.

Camphor has now taken its place amongst the minor products of Ceylon, as will be seen from the accompanying photograph of an upcountry flourishing Camphor plantation. It is now about 15 years since the possibility of Camphor cultivation as an industry for Ceylon claimed the special attention of the Botanic Department. At that time the Superintendent of Hakgala Gardens, Mr. W. Nock, was enthusiastic in extolling its merits, and by practical demonstration of the suitability of the tree to our upcountry climate, as well as of its yield of camphor, succeeded in interesting a good many planters in the new product. From that time forward a large number of plants have been regularly raised at Hakgala from imported seed (and latterly from root-cuttings) and distributed to planters in different parts of the Island, but chiefly at elevations of 3,000 to 5,000 feet. During the last few years many planters and firms have themselves imported seed direct from Japan, and notwithstanding the difficulty frequently experienced in obtaining good seed and the heavy expenses and disappointment incurred in the failure of almost whole consignments to germinate, they have persistently repeated orders and importations, so that at the present time a good number of estates may be found with well-established areas under this product. Some of these are now at a yielding stage, and I am informed that a certain appreciable amount of locally-manufactured camphor is now exported, showing, I believe, good returns.

Camphor is found to thrive at moderate to high elevations, being suited to ravines or wind-blown hill crests where scarcely anything else will succeed; although it may also be grown at almost sea-level, it can hardly be said to flourish under 2,000 feet. Apart from considerations of yield, the Camphor tree is well adapted for shading road-sides and forming wind-belts, the latter affording shelter for tea or other smaller growing crops. It is naturally a dense bushy evergreen tree, furnished with branches to the base; left to itself it grows to a height of 40 feet or more. In cultivation, however, according to the modern method, the plants are coppiced and kept at a convenient height of about 4 or 5 feet.

The plantation shown in the accompanying photograph is five years old, the plants having been raised from seed imported by the owner direct from Yokohama. These have been planted out at a distance of 8 feet by 4 feet apart, in patna land at an elevation of about 4,500 feet. Being primarily of the nature of an experiment the trees were allowed to run up to a height of 15 to 18 feet, when they were cut down to 4 feet, the prunings obtained thereby yielding at the rate of about 60 lb. of camphor to the acre. The coppiced trees have since been clipped with a hedge shears after an interval of about five months, and yielded approximately at the rate of 50 lb. per acre. The Superintendent has since learned from experience that it is best not to allow the trees to run up to such a height, but to top them when about 3½ years old. He considers that when the bushes are well formed they may be clipped at least 3 or 4 times a year, judging by the rate at which they are now flushing.

Clippings obtained from Hakgala Gardens about 6 years ago yielded upon distillation experiments by Mr. Kelway Bamber at the rate of ·75 to 1 per cent. of camphor and from 27 to 34 per cent. of camphor oil. Mr. W. Nock estimated that on an average 14 lb. of clippings per annum could be obtained from each bush. This would work out at about 190 lb. made camphor per acre, *i.e.*, reckoning on the trees being planted 8 feet by 4 feet apart, which would give 1,360 trees to the acre.

SCHOOL GARDENS.

(*Illustrated.*)

BY H. F. MACMILLAN.

That the School Gardens in Ceylon are doing good work, both by example and precept, is now generally recognised. The accompanying photograph shows only a corner of a flourishing garden at a lowcountry Buddhist vernacular school. Here the head-teacher and his assistants work with the boys for a certain specified time, showing plainly that there is no degradation in doing so. The boys too seem to enjoy the relaxation that work in the garden affords from the class-room, and are thus taught to look upon physical work as an enjoyment rather than drudgery. The School Gardens have recently undergone a thorough inspection by their Superintendent, Mr. C. Drieberg, with Dr. Willis, Director, Royal Botanic Gardens.

CAMPHOR TREE IN HAKGALA GARDENS. *Photo by H. F. Macmillan.*

A CAMPHOR PLANTATION AT 5,000 FT. IN CEYLON.

Photo by H. F. Macmillan.

A SCHOOL GARDEN IN THE LOW COUNTRY.

Photo by H. F. Macmillan.

AGRICULTURAL CO-OPERATIVE SOCIETY.

From the book of Rules of the Natal Society we extract the following :—

SPECIAL RULES.

IV. The liability of the Shareholders is limited to the amount of their individual holdings.

VI. *Ordinary Shares* shall be of the value of each per share shall be paid on application, and the remainder in such calls as the Committee may from time to time direct, at least two weeks' notice being given for the payment of every such call.

VII. The *net profits* arising from the general business from the Society, after providing for the payment of interest on share capital at the rate of eight per cent. per annum, shall be allotted as follows :—

(1) Not less than per cent of the net profits shall be allotted *to the workers employed by the Society* in proportion to the wages earned by them respectively during the period to which the division relates.

(2) At least one-half of the net profits shall be carried to the Reserve Fund until the latter equals the share capital. When the Reserve Fund equals the share capital, the general meetings shall decide as to the amount to be placed to the Reserve Fund in each year thereafter.

(3) The remainder of the net profits shall be divided amongst the members in proportion to the amount of their dealings with the Society during the period to which the division relates, provided (that the sum, if any, so divided amongst non-members shall not exceed one-half of the sum to which they would be entitled as members), that no non-member shall participate in the net profits of the Society.

IX. No dealer in or agent for the sale of agricultural requirements, nor any person dealing as trader in or agent for agricultural produce, shall be eligible for membership of the Committee of the Society, or for appointment as an officer.

GENERAL RULES.

21. The interest and dividends payable upon the share capital held by any member shall not be paid to him until all the shares which he is required to hold are fully paid, but shall accumulate and be credited to him from time to time as share capital until such shares are paid up.

23. All sums due from any member, for subscriptions or otherwise, shall be recoverable from him, his executors or administrators, as a debt due to the Society. The Secretary shall lay before each ordinary business meeting a return of all such sums, and thereupon the meeting may—

(1) Direct the Committee to take legal proceedings for the recovery thereof;

(2) If the sum is due in respect of a share, declare such share to be forfeited if any payment thereon has been in arrear for three calender months.

28. Subject to the payment of, or a sufficient provision for, all subsisting claims on the Society, the Committee may from time to time apply any moneys which they cannot profitably invest to pay off the excess of shares held by those who hold the largest number above those who hold the next largest. Provided that no member be required to accept less than the full sum paid upon each share paid off, and that the number of shares held by any member shall not be reduced below the number required, by the rules of the Society, to be held.

68. Subject to the provisions as to the Manager of the Society hereinafter contained, the Committee shall control all business carried on by or on account of the Society. They shall from time to time engage, remove or discharge all assistant managers, salesmen, or employees of any description, other than manual workers, required to conduct any such business, and fix their duties, salaries, or other remuneration, at such rates, and require them to give such security, in such forms approved of by them, as they determine. They shall decide on the evidence to be produced for establishing the claim of any nominee, executor, administrator, or official trustee to any share in the Society, and may institute, prosecute, compromise, or refer to arbitration any suit, debt, liability or claim against, by, to, or on the Society; and in any case for which the rules of the Society do not expressly provide, may exercise any power which could be exercised by the Society in general meeting, other than such as by the law for the time being relating to Industrial and Provident Societies may be required to be exercised by such meetings, and so that in the exercise of any such power they do nothing inconsistent with the previous resolutions of such meetings. And all acts or orders done or given by the Committee in the name and on behalf

of the Society under any power hereby given them, shall bind the Society and every member thereof as fully as if they had been acts or orders of a majority of the members of the Society, at a general meeting thereof, acting in exercise of the powers given them by the rules.

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PACKING FRUIT FOR EXPORT.

BY J. G. TURNER,

Senior Inspector of Fruit Exports and Imports.

Since the publication, in former numbers of this *Journal*, of articles on the packing of fruit for export, new conditions have arisen. These conditions owe their existence to the inception of the new regulations which has been brought into operation within the last year or so, viz., The Commerce Act and the Fruit Cases Act. It is therefore thought

necessary to bring before these growers, who may be unaware of the new laws, the principal points to be observed in putting up their produce so as to conform with all requirments.

In the endeavour to establish and maintain a profitable oversea market for the rapidly-increasing output of our Victorian orchards, too much attention cannot be given to the important item of putting up fruit in an attractive and honest manner. In advices received from the United Kingdom, South Africa, and other oversea markets, the one key-note is invariably sounded: "Pack nothing but the choicest fruit, grade evenly, pack full cases and pack them honestly throughout; inferior, badly graded, diseased and dishonestly packed fruit we do not want at any price, as it gives us more trouble than it is worth, injures the good reputation of other shipments and results in loss to every one concerned." Growers cannot give too much attention to this important matter. It is obvious that it costs just as much to pick, pack and export inferior fruit as it does to handle only the best. Against this labour the grower often realises dead loss or bearly sufficient profit to pay his expenses, to say nothing of the bad reputation gained —a reputation unfortunately shared by other growers who have taken trouble to put up only the best. It may be said that nowadays with our Vegetation Diseases Act, Fruit Cases Act, and Commerce Act, it is impossible for any but the choicest of fruits to be shipped for export; but, unfortunately, such is not exactly correct. The grower may put up fruit of an uneven size, or his fruit may be too green or withered or over-ripe, or packed in newspaper or other inferior wrappers. Under certain circumstances none of these faults can be dealt with under existing enactments, but there is no doubt that fruit put up under such conditions will soon find its proper level. Were it not for the damaging effect of these inferior consignments upon high-grade shipments we could afford to ignore them. Happily shipments of this sort are becoming rarer every year as our knowledge of export requirements advances.

The necessity for our growers paying attention to even the smallest points, so that they may not be left behind in the race, is becoming more apparent every year. Although we have, so far, enjoyed almost a monopoly of the Continental markets as far as antipodean fruits are concerned, the entry of such new competitors as Cape Colony and Argentine Republic should awaken in our growers the determination to hold first place for all time. The immense possibilities of the market before us are practically undreamt of. Taking the United Kingdom alone, we find that out of the immense quantity received there from all parts of the world, Victoria contributes only one case out of every thouand. The demand of the United Kingdom for foreign-grown fruit is ever on the increase. That this is so is shown by the following figures :—

Years.	Values.
1845	£886,888
1865	£3,185,984
1885	£7,587,523
1905	£9,983,119

When it is remembered that the above figures do not include the importations into foregin countries some idea may be gathered of what may yet be done by the growers of this State towards sharing in this enormous trade. That our opportunity is all the more inviting is shown by the fact that nearly the whole of the supplies of the foreign-grown fruit is drawn from the Northern Hemisphere; also that at the time of the year when we are forwarding our shipments the markets are comparatively bare. To grasp and to hold that opportunity certain conditions must be observed :—Economy in production, honest packing of high-grade fruit, cheap regular and invariable oversea carriage and businesslike supervision and control of output at each centre of distribution. And not the least of these conditions is :—Honest packing of high-grade fruits.

Varieties.

In selecting varieties for export it will be better for the intending shipper to confine himself to not more than five or six varieties at most. It is preferable to work up a reputation on two or three standard varieties which are in constant demand than to spend much time, effort and cash in pushing varieties about which little or nothing is known by the trade or consumer.

Passion Fruit.

The recent successful landing of passion-fruit at London should prompt out growers to send more of this most delicious fruit. Trade should commence in a small way, with say, two or three consignments in the first season. As the fruit is not yet too well known in the United Kingdom, it will require writing up and pushing to work up what is bound to become, in time, a big business. Those experts who have tasted our Victorian passion-fruit state that they are unequalled for flavour, size and appearance, and compare favourably with any grown in any part of the

world. These fruits will carry in ordinary export cases. Each fruit should be wrapped to prevent the spread of any decay, but for trial shipments, growers should pack in different ways, in order to find out the best methods of carriage.

CITRUS FRUITS.

Citrus fruits sent to London from this State have, so far, had no success worth speaking of. Nevertheless, the success of the Italian and American growers in landing oranges and lemons on the Melbourne wharf after a journey of several thousand miles shows that it is possible to carry citrus fruits in perfect order. Similar fruits have been received, from China, in trays and ordinary cases in perfect order. It seems from observation of these consignments, that the essentials to success are:—Send only prime, thin-skinned, well-cured fruits, wrap each in dry tissue-paper and pack in boxes or trays so that the contents may not be shaken about. Experimental lots might be also sent to the United States. In May last, oranges were selling up to 14s. 6d., and lemons 21s. per case, at San Francisco. Oranges should arrive in London from about the middle of August until the end of October. Lemons are not so likely to be payable as oranges, because of the regular supplies of stored fruit in large quantities and at low rates.

CONCLUSION.

See that the highest standard of quality is maintained throughout every season; remember that one inferior consignment will do more damage to a grower's reputation than a whole season's effort will efface; ship consignments under a few brands as possible (one preferably) and do not change your brands; co-operate and thus save expenses at this end; concentrate and save expenses at the other end.—*Journal of the Department of Agriculture of Victoria*, Vol. VI., Part 2, February 8th, 1908.

TOBACCO BREEDING.

The prosperity of the tobacco industry as a whole and of the growers in particular depends on the development of improved varieties of tobacco adapted to the demands of manufacturers and consumers. There is no crop which responds so readily to breeding as tobacco, as has been proved by the experiments of the writers, and it is further true that without careful selection and breeding there is no crop which so quickly deteriorates in yield and quality. The extent of the areas in the United States in which the conditions of soil and climate are suitable to tobacco culture is almost unlimited, so that it seems possible that by giving attention to the production of varieties adapted to those conditions, this country can continue to produce an increasingly large yield of valuable tobaccos.

The experiments of the writers have shown that it is possible to increase the yield and improve the quality of the crop by seed selection and breeding. The methods of breeding worked out in the course of these experiments are simple and practical, and can be carried out by every grower with little or no extra cost in the production of the crop. The fact that tobacco is perfectly self-fertile and that self-fertilised seed produces more uniform and better developed plants than seed resulting from cross-fertilisation within the variety makes it possible by the adoption of proper methods of saving seed to make rapid progress in the improvement of the crop. Improvement in the shape, size, and quality of leaves or increase in the number of leaves borne by the individual plants, all of which can be attained by breeding, means increased profits to the growers and manufacturers, and therefore is of vital interest to all who are interested in the production, manufacture, and consumption of this crop.

The production of new varieties of tobacco by hybridisation and selection is a most important phase of tobacco breeding. The new hybrids of native New England varieties with standard foreign-grown varieties, combining certain valuable characters of both parents, described in this bulletin, are good illustrations of the use of breeding in the improvement of the tobacco crop. The making and testing of hybrids are matters of experiment and require considerable time and expense, but experience has shown that the results justify the necessary expenditure.

The production of improved breeds of live stock and varieties of fruits and cereals, in fact, of all crops, might be cited to prove the importance of applying the principles of breeding to the tobacco crop. It is only recently that systematic breeding experiments have been undertaken. It is hoped that the results of the experiments cited in this bulletin will serve as a means of creating general interest in this subject and of inducing investigators, breeders, and growers to turn their attention to the further improvement of their crops.

Tobacco growers in the sections where these experiments have been carried on have generally adopted the improved methods of bagging carefully selected seed plants and of separating the seed, and they are using the improved varieties of tobacco produced in the course of these investigations. In most of these districts certain men have become interested in the careful and systematic breeding of tobacco.

From the practical standpoint, there is no more important problem in tobacco culture than the production of uniform crops. A lack of uniformity in the crop not only results in a low yield, as a whole, and more especially of the best and most profitable grades of the cure and fermented product, but also increases the cost of sorting out the different types of leaves into their respective grades for market, the expense of which must be borne directly or indirectly by the grower.

The principal cause of the lack of the uniformity in tobacco is cross-fertilization. In tobacco, as in all other crops, seed resulting from cross-fertilization produces many plants unlike either parent. Therefore such seed is undesirable for the general planting of a crop where uniformity is so important a factor. Where the tobacco seed plants are grown without protection from cross-fertilization some of the flowers are cross-fertilized by insects or other agencies. Desirable plants may thus be crossed with undesirable plants in the same field or in the adjoining fields, and the plants grown from the seed thus produced are usually extremely variable, some of them resembling the desirable plants from which the seed was harvested, others resembling the inferior plants from which the pollen was carried for crossing, while the remainder are of an intermediate type, unsuited to the purpose for which the crop is grown, and therefore causing a loss to the grower. The writers have observed numberless cases in different tobacco-growing sections where several distinct and worthless new types appeared in the fields, the plants of which were grown from carefully selected seed. These undesirable types could only be accounted for by the accidental crossing of the seed plants the year preceding or at some previous time. The crossing of individual plants of the same strain, even if both are desirable plants, results in undesirable variations, many of which are apparently reversions to earlier and unimproved types of tobacco.

In those varieties of tobacco in which the buds are removed long before the flowers open on all of the plants except those saved for seed production, or where early topping is practised, the opportunity for crossing of the flowers borne by the seed plants with other plants in the same field is almost wholly limited to the seed plants. However, it frequently occurs that late or diseased plants, or possibly sucker branches that have been overlooked, develop flowers which open at just the right time to allow insects to carry the pollen from these flowers to the seed plants and thus effect cross-fertilization. There is little doubt that many of the plants of irregular and unusual types are produced as a result of this kind of cross-fertilization.

An important cause of variation in tobacco plants is the use of immature seed. Many growers cut off or harvest the seed heads before all the seed pods have turned brown; hence before maturity. The writers have observed hundreds of instances where the seed plants have been cut off while many of the flowers were still in bloom. On such seed heads seed pods in all stages of maturity can be found. Some of the pods are fully ripe and contain mature seed, while others have not fully developed. Much of the seed is immature and contains little food for the nourishment of the plantlet. These seed heads are frequently thrashed out with a flail or the pods are crushed by hand in order to shell out the seed. In this way the immature seed is mixed with the ripe seed sown in the seed beds. In the seed beds the immature seed frequently sprouts earlier than the mature seed, and the early seedlings grown from such seed are naturally seed for transplanting in the field. Such plants have a great tendency to vary, in some cases being very early, and as a rule having leaves that are small, coarse, and wholly undesirable for any purpose. These weak, immature tobacco seeds, according to careful and extensive observations by the writers, produce plants which are more subject to certain diseases, particularly the mosaic disease, than are plants grown from mature seed.

The excess of plant food in the soil where heavy applications of barnyard manure and commercial fertilizers are used is usually thought to produce variations in the plants. This variation is usually shown by an increase in the size of the leaves, which is generally correlated with changes in colour, flavour, and other characters. In these cases there is usually a tendency for the type of plant to break up, so that the uniformity of the crop is disturbed. Where it is necessary to use large quantities of fertilizers in the growing of a profitable

crop, the inclination to variation induced by this extensive system of cultivation must be controlled by the most rigid selection of seed from the type of plants best adapted for the purpose for which the tobacco is grown.

In the production of improved varieties of tobacco by breeding, variation in type can be secured by crossing, and by continued saving of self-fertilized seeds from plants most nearly reaching the growers' ideal of perfect plants uniform types can be fixed. Growers will frequent-find plants that are markedly better than the rest of the plants in the field, so that by selecting these desirable variations a steady improvement in the yield and quality of the crop can be effected. Variation, therefore, is a basis for selection in an experimental way, but in practise every effort must be put forth in order to secure uniformity of the plants in the field and thus produce the most profitable crops.

THE INTRODUCTION AND ACCLIMATIZATION OF VARIETIES.

The introduction of the seed of standard foreign-grown varieties of tobacco has been the source of increased wealth and prosperity in certain tobacco districts of the United States. In other regions such importations have resulted in great financial loss to the growers, which in most cases has been due to a lack of knowledge of the effect of the change of soil and climatic conditions on the particular type of tobacco grown.

The western Florida and southern Georgia Sumatra tobacco industry is an illustration of the successful introduction of a foreign grown variety of tobacco. Tobacco growers in this region secured small samples of the seed of the Sumatra variety of tobacco from the island of Sumatra. At first small experimental crops were grown and seed saved from the best plants in these crops. In the course of this experimental cultivation it was noticed that the plants grown under the partial shade of trees in freshly-cleared fields produced finer and more desirable leaves for cigar wrappers than the plants grown in the open. This fact led to the erection of an artificial shade over the fields, made of slats laid on a suitable framework. This method of growing tobacco was introduced about 1896 by Mr. D. A. Shaw, of Quincy, Fla. Later, other growers used a coarse cheese cloth as a substitute for the slats. The shade method of growing tobacco in this region has developed rapidly, and at the present time several thousands of acres of tobacco are grown under either slat or cloth shade, and the industry has become established on a profitable and successful basis. During this time considerable attention has been paid to the production of a uniform type of tobacco adapted to the climatic and soil conditions of this section by the saving of seed from carefully selected plants of the Sumatra variety.

When Sumatra seed was first introduced into Florida, the variety broke up into a number of different types, some of which were desirable, while others were undesirable. By reason of the small crops grown from such seed, the loss to the growers from the production of undesirable types of plants was not very great. The growers naturally saved for seed those plants which produced the most desirable types of tobacco, and as a result of continued selection of this kind a fairly uniform type of tobacco which was adapted to the local conditions in this section was secured. As the demand for this Florida-grown Sumatra tobacco developed, resulting in the increased acreages, seed was at hand which was throughly acclimatized for planting the larger area devoted to this crop. From time to time the tobacco planters in this region have obtained small quantities of seed from Sumatra, but in such cases this seed has been grown in a very limited way in very small fields until it has been acclimatized and uniform types have been secured by seed selection.

About the time of the Cuban revolution it became apparent that the supply of Cuban-grown tobacco for the use of cigar manufacturers in the United States might become limited by reason of the unfavourable conditions for tobacco growing then prevailing in Cuba. Under these circumstances it was thought to be propitious time to introduce the growing of Cuban tobacco into southern Florida, where the conditions of climate and soil were believed to be similar to those of Cuba. Considerable public interest was aroused in this project, and as a result large quantities of Cuban-grown seed were secured and planted in sections of Florida. The crops raised from this seed proved to be a disappointment to the growers. The change of soil and climatic conditions resulted in the breaking up of the type of the Cuban variety into a large number of sorts, some of which were desirable, while others were undesirable. Many of the plants developed a branching habit of growth, bearing very small, undesirable leaves of poor quality, resulting in a very low yield of an inferior tobacco. One of the main causes of failure was the lack of understanding on the part of the growers

of the effect of the change of conditions on the type of tobacco and their neglect to appreciate the necessity of securing strains of plants by seed selection of the desirable types adapted to the particular conditions of soil and climate in southern Florida. If the acclimatization of these strains had been accomplished by seed selection in small fields, with little loss to the growers, the strains could have been grown on a more extensive scale with better chances of success.

In order to illustrate the necessity for the acclimatization of a variety of tobacco before it is grown on an extensive scale, the successful experiments of the Bureau of Soils in the introduction of Cuban tobacco in Texas may be cited. After a previous unsuccessful attempt by farmers in Texas to grow Cuban tobacco from freshly-imported Cuban seed, the Bureau of Soils began systematic experiments in growing small fields of tobacco and saving seed of the most desirable plants according to the method described in this bulletin. In these crops certain plants were found which produced leaves possessing the flavour and aroma desired in a high-grade filler tobacco. The seeds from these plants were saved under bag, and their product has been found to possess the desirable characters of the parent plants. This tobacco has been sold at profitable prices, and the area devoted to the growing of this crop is being gradually extended in order to meet the demands of the manufacturers for this grade of filler tobacco. In northern Florida the tobacco growers, as a result of their experience with the imported Sumatra seed, experimented in growing, in the open, small fields of a cigar filler tobacco of a variety, the seed of which was originally introduced from Cuba. This variety of Florida filler tobacco is now being grown extensively and profitably in that section.

The writers during the past season planted in Florida Connecticut-grown seed of the Sumatra variety. It was found that while there was a noticeable change in the shape of leaf and in some minor characters in the Florida-grown tobacco, there was no violent breaking up of type or indication of unusal variablity. This experiment and other observations have led the writers to believe that the effect of changing seed from the north to the south is not accompanied by such marked changes as when seed is taken from tropical conditions to northern latitudes.

In summing up the observations on this subject it can safely be said that it is a dangerous policy to plant large crops of tobacco with imported seed or with seed from a very different section. In most cases it has resulted in failure and caused considerable loss to the growers. The general crops should be planted from seed produced under the same conditions as the crops which is to be grown. If it is necessary to change the seed or desirable to test imported varieties, it should be done on a small scale, followed by a most careful selection of seed plants, and the seed should be saved under bag, safe from cross-fertilization.

On account of the large quantity of seed produced by a single plant under normal conditions, and the fact that the various characters of a tobacco plant are inherited so strikingly and uniformly by its progeny, the following year when the seed is saved under bag, protected from cross-fertilization, it is possible for the tobacco grower to secure uniformity with a considerable degree of improvement in type, quality, and yield by one year's selection. One plant often furnishes enough seed for an entire crop, and the plants raised from this seed always produce a very uniform lot of tobacco when cross-fertilization is not allowed to take place.—*U. S. Department of Agriculture. Bull. 96*, March 12, 1907.

THE PRINCIPLES OF SEED-TESTING.

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While Botany, like other subjects of study, will always have its followers who pursue it for its own sake, or because of the increase of knowledge of Nature its successful prosecution brings, there are others who through taste or other cause devote themselves to botany from the applied or economic point of view. The magnificent work done by the English botanists in the nineteenth century was due, in large measure, as Sir J. Hooker himself once told me, to the demands of people at home and abroad for information as to the nature and uses of the plants forming the flora of our newly-acquired Colonies. It was, on the other hand, the absence of Colonies before 1880 which helped to produce the splendid results in anatomical and physiological botany for which Germany became famous.

There are two branches of economic botany, the foundations of which have been laid practically within the last fifty years—that bearing on plant diseases or plant-pathology, and that of seed-testing.

It may not be out of place here for me, as a former student and teacher of the Royal College of Science, London, to call attention to what appears to a botanist a peculiar lack of appreciation of the modern developments of botany in the hesitation shown as to the future of the Biological Division, in the Report of the Committee on that College's conversion into a more strictly technical or applied College of Science. If the Committee were familiar with the beneficial work carried out in Germany by Frank, Hartig, Von Tubeuf, Aderhold, etc., in the Biological Institutes of Berlin, Munich, and Hamburg, and in France by Prillieux and Delacroix, etc., there would surely be no inclination to suppress the Biological Division, but rather to develop it along economic lines. Even if there were no ordinary students this division could make an ample return for all expenditure on it by additions to our knowledge of benefit to agriculture, horticulture, and other branches of economic botany.

It was in the year 1869 that seed-testing, as now understood, started. Nobbe of Tharand was asked to examine a grass mixture, and found the sample was not true to description, a remark which applied to many other samples he then obtained from various parts of Germany.

Although the credit of starting the first Seed-testing Station must be given to Nobbe, measures had been taken as long ago as 1816 in Switzerland to suppress fraud in the seed trade. Thus an inspector had the right of entry into a seed shop or warehouse for inspection of the seeds on sale, punishment following detection of fraud. In England in 1869 the Adulteration of Seeds Act was passed, making it penal to kill seeds kept for sale. The Royal Horticultural Society of England did much to expose the corruption which had crept into the seed trade. In its second report (Farmer's Magazine, February, 1869), the Royal Horticultural Society Committee says: "... Everything is thus thrown upon the honesty of the dealer. He fixes the prices, regulates the quality, and the purchaser is kept in the dark, and has no check upon either. This is a temptation beyond what the average frailty of human nature ought in fairness to be exposed. ... One of the chief functions of the association (of wholesale seedsmen) is ... the regulation of prices .... and the determination as to what kind of seeds should have their average lowered and to what extent it should be done." With honourable exceptions trade catalogues offered in addition to "nett or pure seed "trio" seed, *i.e.*, seed killed for admixture purposes! The Act of 1869 made the admixture of killed seed an offence, but did not provide machinery for the detection of the offence, as is now the case for artificial manures and feeding stuffs under the Fertilizers and Feeding Stuffs Act of 1893.

In 1900 the English Board of Agriculture appointed a Committee to enquire into the conditions under which agricultural seeds are at present sold, and to report whether any further measures can with advantage be taken to secure the maintenance of adequate standards of purity and germinating power. This Departmental Committee recommended the establishment of one central Seed-testing Station under Government auspices, with the fees so fixed as to encourage seedsmen to sell subject to reselling by the purchaser, should he desire it. So far this recommendation has remained a dead letter in Great Britain. A Government Station was already in existence in Ireland when the Committe was appointed, and so far some 6,000 samples of seed have been tested by it.

The revelations of fraud and ignorance published in 1875 by Nobbe in his Handbuch der Samenkunde led to vigorous action, and Seed-testing Stations were started in nearly every country in the world, mostly under Government control. At the present time there are some 150.

The object of each Station is to assist the seedsmen and the farmers in securing the best and purest seed for agricultural or other purposes. Evidence abounds to prove that where in any trade there is a demand for inferior goods the supply will be forthcoming, and that where there is ignorance on the buyer's side the seller will, in too many cases, take advantage of it and try to profit by it. These statements are not universally applicable in the seed trade. They hold true, however, to such an extent as to necessitate the existence of Seed-testing Stations to determine for all parties concerned the nature of the goods under sale. It is not necessary to label the good and bad kinds. While in appearance and price there is little to distinguish the two kinds of seeds from one another, the test shows an enormous difference.

As many of my readers are probably not familiar with the qualities which characterise a good seed, or with the procedure followed in ascertaining these points, I propose in the following lines

to describe briefly the more important points. In examining a sample of seed one's attention is directed to

I. The Genuineness.

By this is meant that the seed is really what it is described as being. A farmer who orders meadow fescue and is supplied with the much cheaper perennial rye, is defrauded. The two seeds are very similar in appearance, and lend themselves to deception. A farmer who orders turnip seed and receives the cheaper rape, loses money in the purchase, and further gets a crop of green tops instead of fleshly roots. Charlock, the yellow mustard-like pest in potato, corn, and other fields, has a seed very like turnip or rape, and often, apart from taste, needs the microscope for identification. At one time charlock was largely mixed with turnip or rape, and often, to hide its presence in the seed, was killed before mixing, to prevent its appearance in the field, on the principle, as was well stated, that "dead men tell no tales." Owing to the tendency of turnips and swede to bolt, the general similarity in appearance of the seeds of turnip, swede, rape, and charlock (all members of the genus Brassica), and to the consequent danger of fraud, cases occur every year, in my own experince, in which the Seed-testing Station is called in to decide as between buyer and seller. The clovers at one time were far from being genuine. Nobbe quotes a letter from a Continental firm offering to a seedsman quartz stones so agreeing in size and colour with red clover or white clover that the ordinary farmer could not distinguish them. English red clover has a high value in the trade, but every season is not favourable to the general maturing of its seeds. The supply falls short of the demand, and other less hardy red clovers are liable to be substituted. In such cases the genuineness is generally ascertainable by examination of the seed impurities.

Several seeds in falsely called English red clover are foreign, and never occur in England. By the examination of such impurities Stebler of Zurich has, during the past twenty years, collected most valuable information as to the country of origin of seeds, and his results are now in course of publication. Advantage of the knowledge of this means of identification is sometimes taken by the grower. Thus Russian flax seed, which has a reputation for strong growth, has a common impurity called "false flax" (*Camelina sativa*). The grower of flax in another country, knowing this, sometimes introduces a little false flax seed into his flax seed to give the impression that the seed is genuine Russian-grown. The meadow grasses (Poa sp.) differ greatly in value. The seeds of the different species possess definite botanical characters, but these characters can be so far removed by cleaning machinery that the cheaper, more easily obtained seed can be substituted for the dearer, better kind. The ordinary buyer could not be expected to know the difference. Must he then continue to be, because of his unavoidable ignorance, the possible victim of fraud?

2. Purity.

By practical purity is meant that the seed is not only true to name, but that it contains nothing else in measurable quantity. The two chief sources of impurity are inert matter, such as stone, particles of soil, broken seeds, stalks, chaff—all dead weight—and the seeds of other plants, chiefly weeds. Great improvement has taken place in this branch of the seed trade. The better houses have often elaborate machinery by which the impurities are removed. Unfortunately, however, these very impurities find a ready market, and the supply within the trade is not equal to the demand!

Many of the weed seeds are highly objectionable or injurious. The dodder is very generally present in some clovers, and may do a great deal of harm as a parasitic pest. The dodder seed is in size and colour so like a particle of soil as to be indistinguishable to the farmer. Fortunately for Ireland, the dodder does not thrive well, and there are few cases on record of injury to crops caused by it. I had one case before me in 1900 of the destruction of a flax field by the flax dodder, and the correspondent mentioned cases of great damage in some fields in earlier years.

In England the dodder has, I understand, done much harm locally, from year to year, but does not often ripen its seeds. In some of the Continental and American clovers, however, ripe dodder seeds are plentiful. In England an ounce of dodder in a ton of clover is the limit of impurity considered permissible. On the Continent the limit varies —from absolute freedom to from five to ten dodder seeds in one kilogramme of clover. Most foreign clovers contain dodder, and may require several sievings before becoming free from it. At the recent International Conference in Hamburg it was decided to invite from all over the World information as to the prevalence of dodder in the flora, etc. of each country.

The procedure followed in testing the purity of a seed is quite simple. A definite weight, varying according to the kind of seed, is taken from an average sample of the bulk. The impurities of the two kinds already mentioned are separated out, weighed, and expressed as a percentage. A difficulty arises in some cases where the seeds are blind or deaf, *i.e.*, have all the external characters of the true seed, but lack the kernel. This is especially the case in such a grass as the meadow foxtail. In some cases this seed is pure chaff. When the seed is examined by transmitted light the presence or absence of the kernel is observable. In the great majority of Stations these blind seeds are treated as impurities, but where seed is bought by the bushel (or by volume) it would be more equitable to include them in the germination test.

3. GERMINATION.

The seed from which the impurities have been removed is taken, and from it a definite number, varying according to the seed under inquiry—200 to 400 generally—is separated without selection, and placed under suitable conditions of temperature, air, and moisture for germination. At the end of a certain time, from a few days in the case of clovers and flax, to 28 or even 35 days in the case of some of the Poas, all the seeds capable of germinating will have sprouted, and can have been counted. In this way the percentage of germination is obtained. This varies from seed to seed, but should not vary much for the same kind, even from season to season, when the seed is ripe and fresh. Excellent work was done by Mr. W. Carruthers, F.R.S., the Consulting Botanist to the Royal Agricultural Society, when that Society was led to issue a schedule of agricultural seeds indicating the minimum percentage of germination of each kind which the seedsman should be asked to guarantee to the member when purchasing.

The riper and more perfect the seed, the more quickly and uniformly will it germinate. This is called the Germinating Energy, and is usually expressed in an Interim Report. Old and not well "filled" seeds have a low and irregular germinating energy. Some seedsmen seem to act on the view that a seed is never too old to be sold, and save seed from one year to another year on the ground that next season, owing to adverse weather, there may be a shortage of supply. Such prevision and provision are supported by the statement that, in some cases, two-year old seeds give better plants. In the majority of cases, one-year old seed is the best to sow. From two years on, seeds lose their vitality by degrees.

4. TRUE VALUE.

It is obvious that one gets an imperfect idea of the quality of a seed by considering the purity and germination apart from one another. A seed may be pure, but of low germinating power through age, "heating," want of ripeness, etc. Another seed may be very impure, but what there is of it, true to name, may germinate well. Either report alone would be misleading. I had one sample of Timothy grass to test, intended for experimental work. It was pure and looked good seed, but germinated only 10 per cent. It was in consequence useless. Hence it is usual to combine the purity and germination percentage to get the True Value of the seed. This is expressed by the following formula, where :—

P = percentage of purity.

G = percentage of germination, and

T V = True Value,

$$\frac{P \times G}{100} = T\ V.$$

Thus a sample of perennial rye showing 90 per cent. purity and 80 per cent. germination has a true value of 72—*i.e.*, every 100 lb. contains only 72 lb. really good seed.

In the Irish Station the percentages of purity and germination are stated separately.

Many factors affect the germination of a given seed. We are not yet in a position to say what is the best or optimum condition in each respect for the production of the highest degree of germination in the laboratory of each particular kind of seed. In nature the seed is still less placed under the optimum conditions in every respect; it is in consequence usual to assume that the percentage of germination in nature will be 5 per cent. less than under the more or less controllable artificial conditions. Further, 5 to 8 per cent. is allowed as a margin of error in cases of dispute in estimating percentage of germination in the Seed Station. (Advantage is sometimes taken of this by the trade to add on to a Station's report 5 to 8 per cent.) The poorer and more uneven the seed the greater will be the difference in two tests of it even under apparently identical conditions. One is apt to lose sight of the fact that the object of testing the seed should be, not to obtain the highest possible degree of germination under the most perfect artificial conditions, but to secure a good working idea of the germinating power of the seed when

placed under field conditions. Let us now consider in some detail the procedure followed in ascertaining the germinating power of seed:—

1. *Germinating Bed.*—Excepting in the case of some of the larger seeds, they are placed, without previous soaking, directly in the seed-bed, without being in contact with one another. The seed-bed varies. In some cases strong folded blotting paper is used, in others porous clay dishes of varying thickness, in others sand, and in yet others (especially cereals) ordinary soil in flower-pots or saucers in a greenhouse. I shall not stop to mention the practical details to be observed in keeping these media pure. In this Station the same seed is tested in two or more of these media and the average result taken, this being further checked by the simultaneous germination of a "control" seed of known germinating power. I have found this additional precaution very useful in cases of dispute between buyer and seller, and recommend it for general adoption.

2. *Temperature.*—Whatever the nature of the bed may be, it is essential that its temperature should be under control and should remain constant. In most cases the temperature recommended is 20° C. Here our results have been more satisfactory when the thermometer of the incubator was 24° C. Certain seeds (Poa, Dactylis, Beta, etc.) are found to germinate better if they are also exposed each day to a temperature of 30° C. for six hours, in imitation of the diurnal rise of temperature in nature.

(3) *Moisture and Seed-bed.*—The process of dehydration through which a seed passes in ripening has its counterpart when germination is taking place. A dry seed will not germinate, no matter how favourable the other conditions may be. If, on the other hand, a seed is left water-logged it will not germinate, but in a few days die and rot away. The seed-beds used in testing are of a porous nature, in contact by partial immersion or otherwise with fresh water, so that the necessary moisture reaches the seed, generally by capillarity. For most seeds the amount of moisture so obtained is sufficient. This holds true for the seed-bed, whether of porous clay, sand, asbestos, or blotting-paper and for most seeds.

(4) *Air.*—Fresh air is usually provided for in the incubators by ventilators. Seeds are particularly sensitive to injurious chemical substances, whether in the seed-bed or in the gas often used in heating the incubator.

(5) *Light.*—Most seeds seem indifferent to sunlight, *i.e.*, the seeds germinate equally well in darkness or light. It is a popular saying that a seed in nature germinates best when covered by a layer of soil equal in depth to the diameter of the seed. Exposure to direct sunlight brings with it difficulties in regulating the temperature of the incubator. In a few cases, *e.g.*, the Poas—exposure to light has been shown to be distinctly beneficial, expediting the germination of the seed by one to three or four days, or increasing its percentage of germination.

Where the seed is of good average quality, *i.e.*, such as a seedsman should sell and a farmer sow—the foregoing conditions can be kept so generally constant that the test will be quite reliable, and may be safely taken as an indication for sowing purposes of the quality of the seed.

OBJECTIONS RAISED AGAINST SEED-TESTING.

(*v*) *Unreliability.*—Occasionally objectors to seed-testing quote cases:—

(1) In which several Stations have given widely different reports on the same seed.

(2) In which the same seed tested by the same person under different methods has given different results.

The particulars as to the quality of the seed, the number of seeds tested, the use or not of a "control" seed, the temperature of the incubator, the degree of familiarity with the incubator, and the experience of the tester are all omitted.

The difficulty with the Poas is the usual case quoted. They are delicate seeds, but not beyond reliable testing, and, further, they form an infinitesimal part of the seed trade. A few years ago an Irish landowner sent independently to a seed firm, strongly opposed to seed-testing and to me, samples of "tussock" grass seed. The fact that the firm identified this seed of a valuable fodder grass *Poa flabellata*, or *Dactylis coespitosa*, as a worthless grass. *Aria coespitosa*, cannot be quoted as proof of their general unreliability as seedsmen. The Committee was further told that only skilled hands could prepare a uniform mixture of seeds of grasses and clovers. The mixture made in the seed warehouse rearranges itself in the journey to the farm, and needs remixing before being sown. The purchase of mixtures is being, for obvious reasons, more and more discouraged by the farmers' advisers.

Again, some seedsmen object to a Seed Station on the ground that the Station might give to their rivals, perhaps by unfair use of the Staton's report, a reputation which has taken them years to secure. The seedsmen in Germany were at first strongly opposed to the establishment of Stations. Now, however, they see the advantage of a properly conducted one, and in such an important centre as Hamburg they use it freely in their dealings with one another, and with their suppliers and customers.

One seedsman admitted before the Committee that the result of testing by a Continental expert and by his own expert uniformly came very near one another. He knew, he said, when he was buying worthless seed, and supposed the farmers in the West of Ireland went on buying the "blowings" of grass seeds because it paid them to sow them.

(*b*) *Pedigree.*—It is impossible by mere observation or by an ordinary germinating test to determine the pedigree of a seed. As the degree of fixation of the characteristics of an agricultural variety is often of an indeterminate character, the pedigree question is surrounded with natural difficulty, and often complicated by trade interests.

Confidence between buyer and seller, without which no trade could exist, must be largely the determining factor in accepting the statements as to the pedigree of a seed, especially where field experiments are not carried out. The originator of an agricultural or a trade variety would not be so foolish as to supply seed not in keeping with his description, and direct dealing with him should be guarantee enough, pending the field result.

Advocates of seed-testing have never contended that the pedigree of a seed can be tested in the incubator. One well-known firm brought before the Committee samples, in some cases intentionally mixed, of known seeds with very different pedigrees but so similar in appearance that no one, the firm asserted, could distinguish them from one another. Apart from the fact that there is a microscopical means of distinguishing rape, swede, cabbage from one another, it appears to have been overlooked that the common law could deal adequately with the cases. If a seedsman who submitted oats, germinating 78 per cent. and gathered in a rather wet autumn, to sulphur burning to preserve them was, to my knowledge, fined about £150, it is easy, if the law is reliable, to foretell the fate of a seedsman supplying, *e.g.*, mangel mixed with 25 per cent. wild beet. one of the samples submitted. A Seed Station has not, as its main function, the detection or prevention of fraud.

(*c*) *Time-Limit.*—Some firms state that quite half their business has to do with seed they never handle at all. Such speculative trade has its risks to run, and the speculating firm which no doubt receive a guarantee when buying the (foreign) supplies should be prepared to have the seeds it deals in submitted by the British farmer to test.

It has been argued by some that general seed-testing would paralyse the seed trade if customers waited for the results of the testing before sowing. Such delay is quite unnecessary. The same machinery for taking samples under the Fertilisers and Feed Stuffs Act could be utilised in preventing the postponement of the sowing of seeds. It is only the samples taken from the bulk that are required for action under the Act.

It is true that seeds do not ripen equally well each year. Machinery exists for the removal of the unripe seeds, and there are seedsmen who guarantee year by year the same percentage of germination. The buyer should at any rate have the opportunity of knowing the germination percentage of the seed he is buying. There could be a mutual agreement as to a unit of repayment or of compensation in cases where the test showed the seeds to be under or above the guaranteed standard. Such a mutual arrangement has been found workable. The common law could still deal with cases where there was evidence of deliberate fraud. It has come to my knowledge that in England, where certain landlords agee to pay half the cost of the seeds supplied to their tenants, these in some cases arrange for low-priced inferior seed to be actually supplied to them, while the landlord pays for superior seeds and so the whole bill. The tenant does not seem to realise that he more than pays for the difference later on, in poorer crops.

To meet the time difficulty attempts to ascertain the vitality or viability of a seed at once have been made by the use of chemical reagents. Further, Dr. Waller has shown in a very interesting manner that seeds which are alive give an eletrical discharge which he calls a "blaze" current, when a current from an induction coil is sent through the

seed. He has known only one case in which the seed failed to give the " blaze" current, and subsequently germinated. He has had no case of a seed giving a blaze current without subsequent germination. Further, by his method an idea of the degree of vitality of the seed is obtainable. I am hoping to be able, with Dr. Waller's help, to make practical use of his method in seed-testing.

FUNGI ON SEEDS.

One needs very little experience in seed-testing to realise to what an extent seeds harbour fungi. Many of these fungi are saprophytic, and their abundance is one sign that the seed is old and dead. Others are, however, parasitic. They exist as hibernating mycelium in the substance of the seeds and its coats, or in the form of spores attached or clinging to the seed coats or concealed within them, and sprout under the conditions favourable to the germination of the healthy seeds. Several years ago I made an examination of mangel balls showing the pycnidia of *Phoma betœ*, a fungus which does an immense amount of harm in Ireland. As Appel has recently suggested in such cases as *Phoma betœ* and *Helminthosporium gramineum* seed-testing might aid considerably in preventing unsuitable seed from being sown. In this connection it may be mentioned that Rolfs found the centrifugal apparatus helpful in detecting the spores of *Fusarium* lini on flax seeds.

COST OF SEED-TESTING.

Apparatus.—The Station should have several incubators, a greenhouse if possible, a plot of ground, desecting and compound microscopes, a reliable set of named seeds, certain books, at least two rooms—one for the staff, and one for the incubators. £100 would suffice to equip the Station with the necessary apparatus.

Staff.—The Director should be a trained botanist, and should have at least one scientific assistant who would be reponsible to the Director for the accuracy of all the work.

The counting of seeds, washing of dishes, etc., take up a great deal of time, and for these purposes two or three smart boys or girls are necessary. In this station, with 1,500 samples a year to be tested, the Directorship is part of my duty as Professor of Botany in the Royal College of Science. One witness before the Seed Committee thought a central Station would need a Director receiving £1,000 a year, with the necessary staff and equipment.

Coast of Test.—The cost of a test varies very much according to the character of the seed and the extent of the test, being as a rule from 3s. upwards.

In this Station the seedsman pays 2s. per sample for reports on purity and germination; the farmer, however, only pays 3d. Our work is confined to the Irish seed trade, and all fees go to H.M's Treasury.

It appears that no fewer than 850 samples are sent from the United Kingdom abroad each year to be tested, naturally at considerable expense and unavoidable delay. A well-conducted Station for Great Britain under Govenment control would be highly beneficial to British Agriculture. There is evidence from time to time that the existence of this Station has vastly improved the quality, *e.g.*, of the flax seed sown in Ireland. A seedsman selling good seed has nothing to lose, but much to gain, by having his seeds inspected and certificated.

In the rubbish too often palmed off on the ignorant farmer, the Station proves when called in (and most of our testing is done for the farmers in Ireland) a necessary detective.

The Seed Committee makes what seems to me a fundamental error when it says that " the price at which these seeds (certian uncleand seeds of inferior quality sold in Ireland) are sold not unfrequently corresponds fairly accurately to their value." The seed may be regarded as the farmer's raw material on which he expends his money, time, brain, land, men, and farm appliances. If the seed is impure and of low germination, he will have to spend not less, but rather more, of some of these in working up his raw material, and the resulting harvest will bear no comparison with that derivable from good seed. The disparity between the two results will bear no comparison with the difference in the original outlay in money on the two kinds of seeds. If the farmer knows by test that he is buying seed germinating only 75 per cent. instead of 95 per cent. he can increase the quantity sown, and so save loss in one direction. The Station would give him this information.

In the same way the cost to the State of a central Seed Station is trifling compared with the benefit to British agriculture its creation would mean.—*Science Progress* No. 3, Vol. I., January 1907, pp. 483/95.

INDIAN AGRICULTURE.

By Henry Staveley Lawrence, I.C.S., Director of Agriculture, Bombay.

(*Concluded from p.* 235.)

Cotton.

To turn once more to cotton. The statistics tell us that if we include Native States, cotton covers an area of 20 million acres, and produces about 4 million bales, of an approximate value of £30 millions. Very little of this comes to Egland, (about 100,000 bales, worth £¾ million); and since the whole of the rest of the British Empire produces less than 20,000 bales, Lancashire pays some £52 million sterling annually to foreign countries for its supplies.

There are bold men who assert that it is proved by the Indian hand-loom weavers of Dacca that Indian lint is capable to-day of weaving the finest qualities of cloth—and this not from a vanished species of tree cotton as an exploded myth used to declare, but from the ordinary coarse Bengal staple—and that great discoveries are yet possible in the region of electricity and humidity to adapt modern machinery to the use of short staples. Certain it is that during the American Civil War, when Lancashire was starving for the want of 6 million cwt. of American cotton, India came to the rescue and succeeded in increasing the exports to Lancashire by 5 million cwt.

Bombay, the Central Provinces, and Berar contain three-fourths of the cotton area. The better classes of cotton require a longer period of growth than the brief seasons of rainfall in India permit. Except where the soils are extraordinarily retentive of moisture, length of staple depends cheifly on the dates when the monsoon begins and ends. Thus the Khandesh cottons which are sown in June and harvested in October have a staple of about half-an-inch; the cottons in Broach and Dharwar sown in September and harvested in March, have a staple of three-fourths of an inch, and are 30 per cent. more valuable.

The failure of the constant efforts to introduce American and Egyptian varieties, which flourish most favourably with a season of growth extending up to eight months, resulted in most cases from the want of sufficient moisture in the soil for this length of time. In Upper India a further difficulty was added in the injury caused by the frosts, which are liable to occur in December and January. Thus in that region nature appears to demand that these plants, if grown at all, shall be grown between February and November.

This important conclusion was grasped by an officer of the Bombay Department of Agriculture who had studied the cultivation of Egyptian cotton in Egypt, and has led to the successful introduction of this valuable variety into Sind.

Sind closely resembles Egypt in almost every point. It is practically rainless, and derives its life from the Indus as Egypt from the Nile; in area of cultivation it is rapidly increasing, and may before long rival Egypt. Until recently all cultivation has depended on the inundation canals, which fill with water only when the snows in the Himalayas begin to melt in May, and which dry up with the cessation of the flood in October. With this brief season the Sindhi peasant has been compelled to grow a cotton which comes rapidly to maturity and necessarily posssess a short staple. Within the last few years the skill of the engineer has supplied two of the chief canals in Sind with a perennial flow of water, and has revolutionised the agricultural conditions on 700,000 acres, or one-fifth of the province; and yet more magnificent projects are under consideration.

In March, 1904, the department planted 20 acres of Egyptain cotton, and in November obtained an excellent yield both in out-turn and quality. In 1905, 500 bales were produced by native landholders; in 1906 and 1907 this quantity was doubled. The experiment has been seriously checked by an unprecedented attack of boll-worm, which damaged the indigenous and exotic varieties alike; and by the conscientious objection of the Sindhi cultivator to apply the greater amount of labour that is necessary to the cultivation of the superior fibre. But a confident expectation is entertained that eventually Sind will produce 100,000 bales of almost the finest cotton in the world, worth at least twice as much as the indigenous variety.

The Western Punjab is closely allied to Sind, and if success attends the efforts that are in progress to acclimatise Egyptian and American varieties there, the irrigation colonies offer a vast field for their cultivation. But in addition to the substitution of superior varieties for inferior in these exceptional cases, there is much useful work to be done in various directions.

In some tracts, as in Berar, where cotton cultivation is increasing rapidly, and the people have little agricultural skill, demonstrations of the advantages

of sowing in furrows instead of broadcast, and of intercultivation, have proved of value; in tracts, such as Broach, where no improvements can yet be suggested in cultivation, it is believed that hybridisation and selection of seed may improve the indigenous stocks; and everywhere there is imperative need of the assistance of the entomologist. Few plants have a more arduous struggle for existence against the ravages of insects than the cotton. As the season goes on, its enemies multiply; if climatic conditions favour the propagation of insects and retard the maturity of the cotton-boll, the result will be disaster.

The most destructive pests are the boll-worm, the red cotton-bug, and the aphis. Fortunately, India does not possess the American cotton-boll weevil, which has exterminated the cotton plant from large areas in the United States, and which in 1905 was computed to have caused the loss of cotton to the value of £4½ millions. Protective action has not before been taken in India against the importation of plant diseases, and the measures which now enforce the fumigation of consignments of American cotton seed may be placed to the credit of the new department.

In regard to insect pests, the native cultivator is remarkably ignorant and entirely helpless. Many simple and efficacious remedies have been suggested by the Imperial entomologist, the general adoption of which would be of immense benefit to agriculture.

Before I leave the subject of cotton, I may refer to a fact of some antiquarian interest to this Society. Within the last few years there has sprung up a large export of cotton seed to England, amounting last year to 220,000 tons. An edible oil is expressed, and the residue, sold as Bombay cotton cake, is a cheap and valuable food for cattle. Thus there has recently been carried into effect an industrial project which was recommended by this Society 120 years ago, when in the year 1785 it offered a premium for a machine which would convert cotton seed into oil cake.

Food Supply.

The fear is sometimes expressed in India that the increase of population will shortly overtake the supply of food-crops in the country, and alarmists point with apprehension both to the exports of wheat and rice, and the increasing cultivation of fibres, oilseeds, and other non-food crops.

Great changes are occurring in rural economy and vast vistas of speculation open before us. The rise in the prices of agricultural produce demands enquiry. Is it due to temporary or permanent causes? and what will be the effects? In Eastern Bengal, we hear of the prosperity induced by the boom in jute raising the standard of comfort, and thus reacting on prices. If enhanced prices lighten the burden of the obligations of the farmer, what of the labourer and other sections of the community? Will the plague improve the position of the labourer, as the Black Death did in England? Not only in areas stricken by the plague, but in industrial centres, and irrigational colonies, complaint is made of the death of supplies of labour.

No man will be so rash as to maintain that the agricultural future of India is free from peril, but this at least may be said that whatever dangers may be in store, would only be enhanced by any attempt to interfere with the freedom of action of the cultivator. Nor do the statistics support the view that India is within measurable distance of the catastrophe of a shortage of food-stuffs; 185 millions of acres in British India are under rice, wheat, millets, and pulses, and far more than suffice to feed the 240 millions of people dependent thereon.

A few years ago Lord Curzon, investigating the larger question of the expansion of cultivation as a whole, found that in the previous twenty years it had kept pace with the increase of population. At the same time Lord Curzon was led to emphasise the importance of the development of the irrigational resources of India "as the most efficient factor in the increase of agricultural production." At a later date he would surely have coupled with irrigation the application of science to agriculture. We know already that systematic observation and scientific experiment can suggest improvements, and we can judge of the effect of the smallest improvement if it can be applied over an area of 185 million acres.

Oilseeds form another important division. Sesamum, rape, mustard, linseed and groundnut had last year an area of 14,000,000 acres, an outturn of 2 million tons, and a value of £20 million. The examination of these crops can scarcely be said to have begun, and the possibilities of improvement cannot yet be guaged.

Minor Products.

We must leave on one side the numerous minor products of India; the spices and gums which were the earliest attractions of the merchant adventurers; the lesser or more speculative fibres such as hemp and agaves, in which men seek substi-

tutes for cotton jute and silk; narcotics and drugs, such as opium and tobacco, the battle-ground of philanthropists and physicians; the dyes, starches, vegetables, and fodder-plants, each of supreme interest to their enthusiasts; and we will just touch on tea and indigo which merit attention, as being the admitted products of English enterprise.

Tea covers an area of 500,000 acres, almost wholly in Eastern Bengal and Assam, and has an outturn of 2 million cwt. and a value of £6½ million. A remarkable feature of this industry is that within the last five years while the area cultivated has been stationary the production has increased by 25 per cent., and tea-planters ascribe no small share of this great improvement to the researches of the scientific staff entertained by the Calcutta Tea Association, and to the wide-spread adoption of their suggestions as to the treatment of the gardens.

Indigo has long been a subject of sorrowful interest in this country. In its present state of decline the cultivation extends over an area of only 450,000 acres, mostly now in Madras, and the production amounts to 70,000 cwt. valued at less than £1 million.

The dawn of brighter hopes deserves mention. New varieties of the plant have been introduced from Java and Natal, and give a superior yield. Discoveries made at the research station established by the Behar indigo planters and the Bengal Government, are reported to have improved the manufacture of the dye, and may yet enable the natural product to withstand the competition of the artificial.

Departmental Work.

For an adequate appreciation of the agricultural situation, it would be necessary to put before you a survey of the work not only of the Agricultural, but also of the Forest and Veterinary Departments; for questions of afforestation and cattle are intimately concerned with the efficiency of agriculture. The utilisation of valuable manurial supplies for fuel continues to be a grave problem, of which the operations of the Forest Department restricted, for the most part, to narrow belts of hilly country, have as yet provided no solution. The control of cattle epidemics is the first care of the Veterinary Department, and the education of native agency is receiving attention in the old-established colleges of Bombay and Lahore, and in new colleges in Madras and Bengal. In forestry, there is a single centralised institution at Dehra Dun in the sub-Himalayan tract.

The several departments work under the orders of the Provincial Governments, and their programmes are criticised by the recently created Board of Scientific Advice, who issue an annual report of their proceedings. For a more complete account of the work of the Agricultural Department, I must refer all who are interested to the excellent publication issued by the Pusa Institute, and entitled "The Agricultural Journal of India," and especially to the summary contained in the number for July, 1907, of the proceedings of the last conference of the Board of Agriculture.

Amongst the fundamental problems undergoing investigation at the Pusa Institute, we find the fixation of nitrogen by plants and soil inoculation for the purpose of increasing the bacteria; but the study of fermentative changes both in the soil and in the plant is still in its infancy, and the experiments at Pusa and at various provincial stations were alike unsuccessful.

Chemistry.

In chemistry the work has included the determination of available plant food in soils, and of nitrogen compounds in rain and dew; the examination of soil drainage and of the quantity and movements of soil moisture; and the investigation of poisonous elements in certain roots, seeds and fodders.

The chemical branches of the provincial departments are concerned with local problems of drainage and the supply of fertilisers for different classes of soil.

The drainage question is of great importance where large areas are impregnated with alkali salts, and where the new irrigation canals, whether winding through the hills and dales of the Southern Peninsula, or rolling in vast volumes over the sandy deserts of the northwest, raise the water-table with their percolation, and seriously modify the physical texture of the fields.

The introduction of artificial fertilisers has hitherto been believed to be prohibited by their cost; but this view may require reconsideration in the light of more accurate knowledge of the needs of Indian soils, the increase in value of various crops, and the possibilities of the future derivation of nitrogen from the atmosphere by cheap electrical methods. It has been ascertained that of the three chief manures—nitrogen, phosphates, and potash—the first, nitrogen, is far the most beneficial to Indian agriculture, phosphates and potash being already present in sufficien

quantities in many soils. The questions to be solved are by no means simple. The conditions of each definite tract must be considered in order to determine—firstly, the most favourable source of the nitrogen required; *e.g.*, whether farmyard manure, fish, oilcakes, or perhaps, importations of nitrate of soda or sulphate of ammonia; secondly, what is the most profitable amount of nitrogen to apply; and finally, what crops will repay the use of the fertiliser; there will be no doubt about intensive garden cultivation, sugar-cane, or irrigated crops of high value, but with dry crops, such as cotton and millet, much caution will be needed, or the crop may actually be injured in the event of drought.

BOTANY.

In botany the first essential is the identification and classification of the plants under enquiry, for great confusion has resulted in the past from the want of an uniform nomenclature. The magnitude of this task may be guaged from the fact that at Poona, where it was initiated, in a single season over 1,100 varieties of plants from all parts of the Indian continent were grown and tabulated with minute care. To the botanist is assigned not only the determination of varieties suitable to different localities, but also the development of plant-breeding.

America has taken the lead in preaching and practising the gospel cf hybridisation, and if its theories are not acceptable to the older school of botanists in this country its practical benefits are undeniable. In India useful work has already been done in crossing varieties of wheat and of cotton, and improvements of stocks are confidently expected by the expert staff of each province.

ENTOMOLOGY.

In entomology and mycology progress cannot be equally rapid. It has been decided that no scientific officers are at present to be attached to the provincial departments; and the duty of observing the insect pests and fungoid diseases of the whole continent rests on the shoulders of two entomologists and one mycologist at Pusa. It is contended that the economic value of mycological studies has not yet been established in the eyes of Western scientists, but I am not aware whether a sceptical attitude is also adopted in regard to entomology. There is in fact no branch of agricultural work which affords greater promise of valuable results than entomology. The scientific study of insect life is a new idea to the Eastern mind; even the most skilful cultivators are profoundly ignorant of the life history and habits of insects. Thus they mistake beneficial for injurious insects and destroy their best friends; when the sorghum suffers from attacks of the aphis, and the ladybird comes to eat the aphis, the ryots destroy not the aphis but the ladybird.

When the locust and the grasshopper lay eggs in myriads in their fields, they refuse to believe in the existence of the eggs and make no attempt to plough or dig them up; and when the pest developes, they regard it as the visitation of some incensed deity.

In Western India, which is periodically afflicted by the depredations of locusts, entomological enquiry recently saved the Government from heavy expenditure on impracticable measures, and placed their administrative policy for the first time on the sure basis of knowledge.

In regard to the action of certain insects, opinion is as yet divided; take for instance the termite, commonly known as the white ant. Some people maintain that it never attacks healthy living tissue, and is the cultivator's friend in turning up the soil, and improving its texture; others support the native view that it prohibits the cultivation of such crops as sugar-cane in certain districts, and can only be kept in check by profuse irrigation.

I have already referred to the numerous pests of cotton, to the attacks of which so many exotic experiments have succumbled. Last year, a campaign was conducted against the boll-worm, which had devastated the indigenous cotton of the Punjab; it was believed that a parasite, the natural enemy of the bollworm, had been killed off by abnormal frosts, and measures were taken to re-introduce this parasite. It is reported that these measures were remarkably successful, and the conclusion may fairly be drawn that not only for the introduction of imported varieties, but also for the preservation of indigenous stocks, the aid of entomlogy is indispensable.

IRRIGATION.

I hope that these notes may suffice to convince the unprejudiced critic of the potentialities of advantage to the people of India contained in the new agricultural policy; but I am aware that strong-minded friends of mine refuse to be led astray by the dreams of enthusiastic fancy and stand firm in the ancient tradition that the interference of Government in agriculture is, has been, and must always be, pernicious.

Since, however, even these "irreconcilables" admit one exception to this principle in the case of irrigational agriculture, let us consider for a moment the value of this concession. If we refer once more and for the last time to the statistics, we learn that of a total area annually cultivated in British India of 226 million acres, over one-fifth part is irrigated from canals, wells or tanks; and of this area of some 45 million acres, 10 million acres have been brought under irrigation from canals which have been constructed by the State within the last thirty years.

Now, the precarious character of the rainfall is the greatest curse of the Indian cultivator, and a regular supply of water is the chief burden of his prayer. Vicissitudes of drought and flood (and mainly drought) in many tracts threaten his very existence, and everywhere hamper his prosperity and impede the improvement of his cultivation. It is idle to talk of the proper rotation of crops and the value of the selection of seed to a man who is compelled to determine according to the exigencies of each season what crop is likely to come to maturity at all, and to return him a bare subsistence for his labour. Thus, over large areas he will prefer cotton or millet according as the early rainfall of June is scanty or plentiful, and at the last moment open for his choice he will have recourse to the village store, and accept from the trader the remnants of a weevil-eaten seed-bin. His skill and courage in securing a catch-crop in the face of heart-breaking calamities have won him the respect and admiration of all competent judges, but in these sterile regions what hope of improvement of his lot is offered to him by Nature?

It is only in recent years that this question has been seriously taken in hand by Anglo-Indian engineers, but the progress made has been little short of marvellous. Their pre-eminence in hydraulic engineering is cordially recognised throughout the world and needs no commendation here. The conditions with which they have contended have varied greatly; in North-Western India the snows of the Himalayas constitute an inexhaustible reservoir and give a constant supply to the rivers from which canals have been conducted into deserts practically devoid of rain. In Southern India, the rivers starting from the low ranges of the Western Ghats are fed only by the capricious monsoons, and the main canals are either confined to the deltas in the Madras Presidency, or are dependent for their storage on artificial lakes of immense size.

Wherever it has been found possible to construct these canals, agricultural conditions have been revolutionised. Millets, pulses, and short-stapled cotton have given place to sugar-cane, wheat, rice, spices, and oil-seeds.

The traditional lore of the ryot is no longer of any avail, he must learn the methods of cultivation of crops, of which neither he nor his ancestors have had any experience; and the mistakes which he makes are a powerful factor in preventing the full utilisation of the water placed at his disposal. As the man who has never handled a sovereign cannot administer with wisdom a sudden fortune, so the ryot, accustomed to scanty falls of rain, does not know what to do with the streams that permeate his land in copious abundance. He cannot understand that excess of water may be injurious. Over-irrigation exposes his wheat to attacks of rust, damages the quality of his sugar and the fibre of his cotton, and want of drainage renders his fields infertile from water-logging and the rise of alkali.

Here, then, we see a wide scope for the energies of the new department. It is computed that the produce of an acre of irrigated land is in many districts equivalent to the produce of three to four acres of dry-crop land, and the value of the crops grown under irrigation must be a large percentage of the total agricultural wealth of the country. The Government of India is committed to a programme of great magnitude in further irrigational expansion; tracts of country larger than the whole cultivated area of Egypt will shortly be traversed with a net-work of new canals; the success of these canals and the continuance of this policy will be greatly influenced by the skill and rapidity with which the cultivators adapt themselves to the new systems of agriculture required. In facilitating this change, the Department of Agriculture can play a great part, and I venture to submit that, even if we dismiss its other activities as visionary, and regard it solely as the handmaid of irrigation, it will justify its existence.

IRRIGATION IN BENGAL.

The total area leased for irrigation in Bengal during the official year 1907-08 up to the end of September last was 791,822 acres, as against 758,077 acres for the corresponding period of the previous year.—*Indian Trade Journal*, Vol. VII., No. 87, Calcutta, Thursday, 28th November, 1907.

SCHOOL GARDENS.

BY C. DRIEBERG.

A report on School Gardens in the United States by B. T. Galloway, Chief of the Bureau of Plant Industry, indicates the importance attached to this branch of education in America and the progress that has been made in this connection.

Agriculture in its broadest sense is the primary basis of the wealth of a country, and hence the necessity for efforts being made to bring early to the mind of the child, facts which will be of value in emphasizing the importance of agricultural work; and there is no better way of doing this than through a well managed system of School Garden training. This work is also valuable in broadening lines of thought, enlarging the scope of the child's observation, and improving its physique.

The importance of training children through the medium of School Gardens is recognised all over the Continent and in England. The movement has within the past few years spread also to Ceylon, and is just being taken up in India, in the State of Mysore.

Through its Bureau of Nature Study, Cornell University has come into touch with thousands of children in New York State, who have been urged to have gardens of their own and to further the improvement of school grounds. Nature Bulletins are issued to them, giving clear directions, interestingly written, in regard to seed and bulb planting, as well as planning and caring for gardens. Through its efforts more than 500 School Gardens in the State were improved by children in 1904. Primarily, the desire of the University is to aid the children of country schools, but its influence is strongly felt in the City Schools also.

The School Garden is, however, by no means confined to New York State, for we find that Connecticut, Massachusetts, Misouri, Ohio, Pennsylvania and Virginia are also participating in the new educational scheme.

In Ceylon we have already some 150 school gardens, many of which are quite models in their way. At first the working of the school garden scheme fell to the Department of Public Instruction, but subsequently it was transferred to the Department of Botanic Gardens, under which it would appear to more appropriately fall.

What one would wish to see is the inclusion of school gardening among the subjects for the Government Grant, so that the same attention may be given to this most important phase of education as to other less practical subjects of the Code.

It is satisfactory to find that a local movement has been set on foot to promote Nature Study among the children of the capital town, and that "rambles" with the object of encouraging habits of observation in the young, are about to be organised.

NOTES AND QUERIES.

BY C. DRIEBERG.

E. H.—Rozelle is botanically known as *Hibiscus Sabdariffa.* The parts used as food are the fleshy calyces which persist on the fruit. These are largely used in Queensland for jam making, and have also been found to make an excellent jelly and sauce (in place of cranberry). The calyces can be dried in the sun for future use. It is suggested that the juice got from them might with advantage supersede the coal-tar dye used for colouring food a bright red. Another use of the plant is for fibre. For this purpose the crop should be cut while still in flower, dried, made into bundles and soaked in water for 15 or 20 days. The strong silk fibre (Rozella hemp), which is considered equal to jute, is useful for cordage and coarse textile products. The leaves are sometimes used as a salad, and the seeds fed to cattle and poultry.

F. N.—The word lime is very loosely used, being applied indiscriminately to the oxide, hydrate and carbonate of calcium. It is most correctly applied to the oxide, and thus we get hydrate of lime and carbonate of lime. Slaked lime is another name for the hydrate. It is the carbonate that we find in shells, coral and limestone. Magnesian limestone is a compound of calcium carbonate and magnesium carbonate. Crystalline limestone is burnt for lime in the Kandyan districts. Along the South coast coral is used.

H. P.—The planting up of fuel trees might, as you say, pay with the present high price of firewood in large towns. But, on the other hand, with coal at Re. 1 per cwt. (in Colombo) householders can always fall back on it, though native cooks have a strong objection to the imported fuel.

V. P.—The plant you refer to is the Water Hyacinth (Pontederia), plants of which are hawked about in Colombo

and sold for anything between Re. 1 and Re. 3. The Botanic Department has warned the public against allowing the plant to escape from cultivation and become the nuisance it is in Australia.

G. de S.—You will find a reference to the Senegal groundnut in the last Progress Report published in the T. A. & Magazine for March. Apply for seeds early if you wish to have any.

J. C. D.—Yes, I am glad to say the seeds of grape-fruit received from the United States Department of Agriculture have germinated fairly well, and will be ready for giving away in a month's time.

M. F.—The cow pea is an improved form of *Vigna sinensis* which is botanically identical with the different kinds of "mè'" we have in Ceylon. It is an excellent soil renovator, and, as it produces heavy crops of edible beans, should prove a popular green manure. The Florida velvet bean is, on the other hand, unwholesome, but all the same it is hard to beat as an improving crop. The native *Wandurumè* (which produces a hairy bean) is closely allied to it.

Correspondence.

"MELILOT," OR "PEA CLOVER"

(*Melilotus Officinalis*):

A GREAT FERTILISING FODDER PLANT FOR PLANTATIONS.

SIR,—Having frequently read of the great trouble and expense planters have in maintaining the fertility of their land, kindly permit me to give a description of the above plant.

It grows on an Island off the coast of Tasmania and constitutes 75 % of the feed for stock there. In growth it resembles lucerne, with shamrock-shaped leaves, but has very small yellow flowers; and when cut for hay in the flower stage, it has a beautiful aroma, and horses, cattle, sheep and pigs eat it greedily and thrive thereon. It grows from 2 to 3 feet high and yields from 30 cwt. to 2 tons of hay per acre, when not used for grazing. It makes good fattening and dairying fodder. A writer says, in one of our Government Agricultural Gazettes: "This seed has been sown in raw white sand, and in the course of 5 or 6 years it has converted it into dark, almost black rich soil. We are growing splendid crops of lucerne (which requires the very best soil) now where it would have been impossible to do so without the use of 'Melilot.' It is a very rich nitrogenous plant of the leguminous order, and should prove a great boon to planters." An American expert of Botany declares that "a fully developed plant of 'Melilot,' conveys to the soil fully 4 lbs. of nitrogen, and it is unequalled either as a great soil fertiliser or fodder plant. The cattle could also be grazed thereon, and the land doubly enriched thereby."

I have lately been reading that J. B. Carruthers, Esq., Director of Agriculture and Government Botanist for the Federated Malay States, has been searching for a plant for this purpose, and so far has succeeded only in procuring a dwarf thorny species of *Mimosa* (*Pudica*), a native of Brazil, which he says, "fulfils to a much greater degree than any other the required conditions." This plant adds only from 150 to 250 lbs. of nitrogen to the soil per acre per annum, and is unsuitable for other purposes. It cannot for one moment be compared with "Melilot," which, apart from its unrivalled fertilising qualities, can be utilised for pasture or hay. Mr. Carruthers further says: "The introduction of a leguminous plant in rubber estates, to take the place of the weeds which grow so vigorously and are so expensive, means an automatic manuring of the soil, and a conservation of surface soil which will otherwise be washed away. "Melilot" would prove equally valuable on coconut plantations. Another writer in "Tropical Life" on "Coconut Culture," says: "When the land is poor or sterile, it can be greatly improved by planting leguminous crops, which, besides producing an abundant supply of succulent fodder, manure the soil by increasing its supply of nitrogen. Cattle are an invaluable help to the coconut estates, as they give valuable manure, and the grass that is provided

for them prevents the too rapid evaporation of the moisture in the soil."

Yours very sincerely,

B. HARRISON BURRINGBAR.

River Tweed, N.S.W., Australia.

[This plant is simply one of the family Leguminosæ, to which cloves, peas, beans, crotalaria, dadap, and other plants already so successfully used in Ceylon to enrich poor soils, belong.—ED.]

BURMA AS A MARKET FOR CEYLON AND INDIAN TEA.

SIR,—It has often struck me that, while pushing sales of their tea for a field all over the world, Ceylon planters seem to have entirely neglected to do so in Burma, which is at their gates.

The Burman is beaten by no one in the East for his powers of tea consumption. In even the poorest houses the tea pot is going every day and all day. They do not care for coffee at all; in fact, it is rarely or never drunk except in large towns where the task has been acquired. The tea they drink is of Chinese make and is retailed at about one anna a packet of about ⅛ of a lb.

Very possibly—to use a Burmese expression—I may seem to be "teaching the crocodile to swim"; but as I have never yet come across any one trying, or seen any attempt made, to push your teas or those from India out here, I write you this note. Ceylon and Indian teas can be got at all grocers, but in 1 lb. tins at 14 as. to Rs. 1·4 per lb. The ordinary village Burman not only cannot run to this and likes to buy his tea in little lots, just as he can afford it, but he dislikes the flavour of Ceylon and Indian teas, and says they are too bitter—the consequence is that the sale of this Chinese tea is immense. I regret I cannot give you the figures of import, but will obtain them if required, and also, if required, will send you a sample packet of tea sold everywhere to the townsman as well as the villager. If I am "chewing the chewed and grinding the ground," please put this letter into the W.P.B.

The enclosure speaks for itself.*

Yours truly,

J. G. F. MARSHALL.

Tavoy, Burmah, 8th March, 1908.

DIOSCOREA *VS.* YAMS.

SIR,—In your issue for December, 1907, I note that, after quoting my Bulletin on the Yautias, or Taniers, of Porto Rico, you make this statement: "This is the great 'yam' crop of tropical America, but is as yet little known in the East, where the taro (Caladium) is cultivated." Since the crop in question has been most deplorably confused with the taro, I regret that you should have added to the confusion by stating that the tanier is the great *yam* crop. In my eleven years' experience in tropical agriculture, I have never before heard either the taniers or the taros called yams. As you probably know, some types of sweet potatoes (Ipomœa spp.) are in some districts of the United States known as "yams," but all true yams belong to the genus *Dioscorea*, with the possible exception of some species of Smilax.

You would oblige me by correcting your statement in the "Agriculturist."

Yours very truly,

O. W. BARRETT,

Plant Introducer.

Washington, D.C., February 17, 1908.

In Ceylon all "root" crops are generally classed as "yams," even potatoes being included under this head, but it is much to be wished that the name could be restricted to the *Dioscorea*.—ED.]

* A P.O. notice stating that the skins, etc., are prohibited articles.—ED.

THE SUPPLEMENT TO THE

Tropical Agriculturist and Magazine of the C. A. S.

No. 4.] APRIL, 1908. [Vol. II.

RUBBER IN BOLIVIA.

We are indebted to a gentleman (Mr. F. J. Dunleavy) connected with the "Bostom and Bolivia Rubber Company" for a series of picture post-cards, on which are given phctographs taken on the spot illustrative of a practical "History of the Rubber tree product in the making of the Hevea Brasiliensis of the Republic of Bolivia, S.A." We copy the lettter-press on each card:—

B. & B. R. Co., Gomales, Kaka; Mapir and Beni Rivers Bolivia, S. A.

Rubber.—From tree to market. Tapping a rubber tree "Hevea Brasiliensis" preparatory to attaching the tichuelas to catch the latex.

Attaching the tichuela by tapping the bottom of the can with the Machadine (tapping instrument) and placing the can below the wound inflicted to catch flow of latex.

In from three to five hours the tichuela is taken from the tree and emptied into a larger can. The latex gathered is taken to the Humadero (small oven) with orifice on the top to concentrate the smoke. The latex is poured into a dish and a paddle shaped piece of wood is warmed over the hot smoke, then the latex is poured over the paddle and the latter is rapidly revolved. In ten seconds, the latex is coagulated, formed into rubber, cured by the smoke and again latex is added and so on until the latex in the dish is all fabricated into rubber. The rubber is then cut from the paddle and taken to the plantation store awaiting transportation to the markets of the outside world. The loss of weight by drying and shrinking from the time the rubber is received in the store until it reaches the European or American markets, is from 15 per cent. to 25 per cent.

Rubber pickers in the forest at lunch. The Bolivian Rubber Picker is the only independent gentleman in the country. He works very little, has few wants that are easily supplied, a good climate and no responsibility. All that is written about the rubber picker *slave*, is for the novels and people who have never run a rubber plantation. They do not exist in South America, nor did I ever see them in Africa; though I lived there for some years. Slaves do not sit around in the sun eating lunch and smoke cigarettes and take a siesta like those here.

The photographs represent well-grown fresh trees and stalwart men. They can be seen at our office, by any one interested.

RUBBER IN MEXICO.

265, Avenida Vicente Guerrero, Chihuahua, (Mexico), 30th January, 1908.

Dear Sir,—The enclosed cutting from the *Mexican Herald* of 27th inst. may prove of interest to you.—With kind regards, yours sincerely,

CHAS. BALDERSTON.

RUBBER MEN TO MEET.

PLANTERS' ASSOCIATION TO HOLD SESSION FEB. 12.

Dr. Pehr Olsson-Seffer, who returned Saturday night from a three weeks' visit in various parts of tropical Mexico, reports that the rubber planters are all very enthusiastic over the coming meeting of the Rubber Planters' Association of Mexico, which is to be held on Feb. 12th and which will be the second session of that institution. It is certain that all of the directors of the Association will be present, including the President, O. H. Harrison; the first Vice-President, J. C. Harvey; Pehr Olsson-Seffer, the second Vice-President; the directors, including A. B Coate, W. C. Guels, B. Carranze, W. V. Backus, V. Paterson and L. I. Ostien.

The programme has not been definitely arranged, as yet, but it is known that a number of important papers will be read and that the directors of the organisation will have some important business to transact.

Dr. Olsson-Seffer reports conditions on the isthmus country to be excellent. Those rubber plantations which are old enough for a crop this year are producing well. The Zacualpa rubber

plantation, which is on the Pacific side of the state of Chiapas, produced about 50,000 pounds. The Dona Maria in the same district, owned by F. A. Quimby, produced about six tons. La Amistad, which is a small plantation in the same district, owned by V. S. Smith, produced about two tons. All the trees on these plantations are about seven years old.

In the state of Veracruz the El Palmar, which is located near the station of Tezonapa on the Veracruz and Pacific railroad, which will have about 3,700 pounds, and the La Junta, near Sanborn on the Veracruz and Pacific, of which J. C. Harvey is manager, is tapping, but the output is not yet known and the same is the condition existing on the Buena Ventura which is Mr. Harvey's private place.

These are all of the cultivated plantations producing this year, according to Dr. Pehr Olsson-Seffer. The present price of rubber is ninety cents gold per ton.

CARAVONICA COTTON.

Many new plantations of every description are being put under cultivation to rubber and other products, and not a few of the Companies are paying special attention to the new cotton called Caravonica. This cotton was developed a few years ago in Australia, being the result of hybridization between Mexican cotton and Peruvian Sea Island. The result, a cotton tree, grows to a height of from 14 to 16 feet and gives an enormous yield. The return per acre in other parts of the world is 1,200 pounds of gin lint and in addition to such a yield is the factor of a higher price than that obtained by Sea Island. Two years ago Dr. Pehr Olsson-Seffer made his first experiment with this plant in Mexico, the results now proving extraordinary, with still bigger promises. Trees planted seventeen months ago at the Zacualpa botanical station are now sixteen feet high and in full production, 96 bolls having been counted on one tree. The bolls are big and the staple is very long. The tree stands seven years before the necesssity of replanting. Special machinery is required for handling the product.

Several companies are now beginning to plant this seed. One of these is the Tropical Produce company, of New York, which is planting this year 200 acres on the Palmar estate on the Veracruz and Pacific railroad. The San Thomas Cotton Estates, Ltd., of London, will begin in a few months the planting of 200 acres on its property along the Pan-American railroad in Chiapas, and two other companies are just being formed for the purpose of making a specialty of this cotton along the lines of the Pan-American railroad. The plant is purely a tropical growth.

RUBBER PLANTERS' CATECHISM.

We havo received the following letter from a resident in the Far East :—

Sir,—As a planter and investor in plantation rubber in the Malay States, it appears to me that the following pertinent questions, if authoritatively answered, would be of more benefit to the industry and the investor than the windy and often ignorant statements which appear in the columns of various papers.

I would ask you therefore to answer the few following questions, which your undoubted knowledge and possession of statistics should enable you to do.

(1) Can an acre of rubber be brought to a productive stage for £20 inclusive of interest on capital?

(2) Is an average annual return of 200 lb. per acre a fair estimate after six years (dry rubber)?

(3) Is it probable or possible that the cost of putting a pound of plantation rubber on the European market will exceed 1s. 6d. when the forests of plantations are in full bearing?

(4) Is it a fact that hard cured Para, which I presume may be taken as a basis for wild rubbers, cannot be laid down in Europe under 2s. 8d. to 3s. 2d. per lb., according to circumstauces?

(5) Is it a fact that the consumption of rubber in the world is increasing about 10 per cent. annually?

(6) Is it a fact, or only a fancy, that were the price of Para to fall to 2s. per lb. the demand would be practically unlimited?

If you are able to answer these questions in the affirmative the grower or investor in plantation rubber would have this prospect before him :—

Capital £20 per acre.

Average annual yield 200 lb. per acre at an average price of 2s. 6d., deduct 1s. 6d. for production, and we have £10 per acre profit, or 50 per cent.

The question of distance of planting is in my opinion useless to discuss just now, and only the lapse of years can inform the planter what is commercially the best distance to plant. From the forester's point of view there would seem to be no doubt that to get fine trees wide planting is essential; but I maintain that a good forester does not necessarily make the money for his generation, although doubtless he may do so for posterity.

I enclose my card, and sign myself

C. M. C.

TAPPING YOUNG RUBBER TREES.

The younger and smaller the tree the thinner the bark; that statement is generally accepted for most Para rubber trees now under cultivation. The bark of five-year-old trees is so thin that coolies, however skilled they may have

become after many months' experience, are apt to cut into the cambium and wood, thereby making wounds which prevent systematic tapping of the same area for some time to come; it is therefore generally dangerous to tap the bark of such trees at the usual height. But the trunk of a young tree is not of even thickness throughout, the basal part being generally larger than the rest; the increase in size is characteristic of the bark as well as the wood. Hence many planters have, for some time past, been doing their level best, by means of a V system of tapping, to extract paying quantities of rubber from the thick bark in the first food of their young trees. A standard size, when the first tapping of the basal part only may take place, does not appear to exist, each planter being usually guided by the flow of latex secured from individual trees.

One correspondent writes that we may rest assured that planters will not allow any latex to escape, if it is at all possible to collect it at a profit. Certainly the tapping of the basal part only of trees which are admittedly too thin to tap at the usual height lends colour to this declaration. We do not think that any efforts will be spared to secure the maximum quantity of rubber from trees at all stages of their growth; we are more afraid that damage may be done to the young trees by thus taking advantage of a difference in thickness of the bark at different sections. Most investors have profited by experience already gained in the tapping of very young plants, and are now inclined to let the trees have the very best chance to develop into the strongest types so that a regular output of rubber can be reasonably anticipated during the years to come. We have no data before us which would lead us to believe that the latex at the base of a 5-year-old would vanish if not immediately collected; we have reason to expect that the latex if left alone for another year will increase in quality and quantity, and this, coupled with the fact that no advantage is gained by placing young or even old rubber on the market while the present low prices continue, convinces us that the young trees might very well be left alone until they are a little older.

Basal Tapping.

Furthermore, recent investigations suggest that the basal V may not be as beneficial as two basal single oblique cuts on opposite sides of the tree; until this point has been definitely proved t may be wiser to adopt the latter system as it would allow the cooly to tap areas separated from each other with the maximum amount of bark, and only one side need be tapped on separate occasions. The basal system of tapping is generally believed to give a better yield of rubber per area of bark excised and a reduced quantity of scrap than certain other systems; but if it is carried out on young trees and in any way affects the growth of the plants at that age we advise our planting readers to drop it. We are more eager to have a regular annual outturn of rubber from each tree for the next twenty or thirty years than to secure a small return from young and unduly taxed trees. We do not want any temporary relief; we desire the planting polic to be so conducted that permanency and regularity in output can be guaranteed—*India Rubber Journal*, Feb. 10.

SUPPRESSING WEEDS ON RUBBER ESTATES.

The opinions of many rubber planters on the question of suppressing weeds have at various times been laid before us, and we must admit that the subject is one which offers ample opportunity for suggestions and criticisms. The home proprietor or investor knows that the only real item of expense on a large rubber estate, newly planted with rubber trees alone, is that of weeding. An annual report just to hand gives some exact information of the cost of weeding on a well-known Ceylon property. The balance-sheet shows that weeding has cost exactly one-third of the total cost (including clearing jungle, planting, and managerial salaries) of a block of land opened during last year. Another list shows that to weed a plot of 100 acres to the end of the fifth year cost £350, whilo an adjacent plot of 300 acres cost, in weeding alono, up to the end of the 6th year, over £1,600. We could quote instances where the costs of weeding are much higher, but as the preceding figures indicate that considerably over £5,000 may be required to weed an estate of 1,000 acres before the trees are in bearing, the point does not require further emphasis. The planter knows that the work of weeding is one of the most difficult tasks when dealing with newly-planted rubber estates. If any part of the property begins to show a green cover, trouble will assuredly face the planter, either when dealing with his weeding contractors or taking his regular survey in company with the visiting agent. We speak especially of Ceylon, where almost without exception European planters and visiting agents are

wedded to the system of clean-weeding estates, whether they be of rubber, tea, or cocoa. Invent a satisfactory system which relieves the planter of all weeding troubles, and you will see him smile, and will gain his most fervent approbation. To keep the estate free from weeds is the test as to the fitness of a planter to keep his billet in Ceylon. To thus qualify is one of the worrying jobs which the average planter would willingly be relieved of. Planters in Ceylon are convinced that it is impossible to exaggerate the soil loss that must take place when young clearings are, year by year, exposed to tropical heat and rain, and scraped by weeding contractors. Nobody seems to like or approve of the system. The proprietor knows it is costly, the planter regards it as his most troublesome task, and all who have studied the pros and cons pronounce it as injurious to the soil. Why, then, is the system continued? What alternatives can be confidently recommended?

Alternative Schemes in Cultivation.

Many systems have been tried by planters in Ceylon, Malay, Java, Sumatra and Borneo; schemes have been evolved one after the other by the writer and others; money has been spent and experiments have been carried out for several years in succession; and after it is all over the same questions crop up among the planters and are just as enthusiastically discussed in the Press and at planters' meetings. The writer has long ago concluded that the practical man—the planter—knows really what is best because he alone realises what is possible with the labour and cash provided. Most planters know, on an estate with rubber trees only, often from bitter experience, that there is very little to chose between clean-weeding and no weeding; to attempt to weed only three feet around each rubber tree is a dangerous and generally impracticable system. To allow any and all weeds to develop will retard the growth of the rubber plants. If there are any planters who do not believe this, let them try their hand and make careful measurements of the trees on plots cultivated on these systems.

The only practical way out of the difficulty seems to be to interplant the rubber properties with additional crops which will not rapidly run to seed, and in turn become dangerous weeds, or which will, in course of time, give some return as a catch crop before the rubber is ready for tapping. To interplant the rubber saplings with Dadap or Albizzia trees, which grow rapidly and will stand frequent lopping, is one good system; to interplant with cacao, coffee, tea, tapioca, tobacco, etc., is even better, providing the required space is allowed around each rubber tree. Many planters have tried tobacco and coffee in Sumatra, tapioca in Malay, and cacao in Ceylon and Java, in conjunction with Para rubber, and though each country claims to be satisfied with the results, there does not appear to be much change of the system in each of the areas enumerated.—*India Rubber Journal*, Feb. 10.

THE TREND OF THE RUBBER INDUSTRY.

The first month of the new year has been phenomenal in many branches of the india-rubber industry. There has been a gradual decline in the price of fine hard Para and nearly all other grades, manufacturers have hesitated to buy further lots in the hope that the next offer would be another penny down, and interest in rubber shares and plantation developments has almost entirely disappeared. A manufacturer, when conferring with the writer on the current slackness in trade, remarked that he declined to buy more rubber until he could feel fairly sure that prices had touched bottom; he anticipated a further decline, and seriously hoped it would come quickly in order that the hand-to-mouth business might cease and normal conditions be regained. Manufacturers do not rush to buy crude rubber in a declining market at the day's quotation any more than investors seek to increase their interests in rubber companies whose shares show a falling-off week by week. This condition of affairs, manifest towards the end of last year, was continued throughout the whole of the past month; even the bargain hunter finds himself today in a plethoric but confused, uncertain and unsatisfactory state. This stagnation is characteristic of the English, Continental, and American markets, and the moment is opportune for reflecting on its origin and effect.

Liverpool Stock.

The causes which have contributed to create the present depression have been outlined in the first issue of the "India-Rubber Journal" for 1908, and their importance is indicated by the large stock of rubber now on hand.

The following particulars, showing the range in value of fine Para and the stocks at Liverpool during the month of January,

in each year from 1900 to 1908, are of particular interest at the present moment:—

Year.		Liverpool January Stock. Tons.	Value of fine Para. s. d.		s. d.
1900	..	466	4 5½	to	4 9½
1901	..	1220	3 7¼	to	4 0
1902	..	1436	3 2¾	to	3 6½
1903	..	1129	3 7	to	4 1
1904	..	668	3 10½	to	4 4
1905	..	466	4 9½	to	5 4
1906	..	549	5 2¼	to	5 5¼
1907	..	400	5 0	to	5 4
1908	..	2304	3 1½	to	3 5½

There is a difference of approximately 2s. per lb. between the prices ruling for January of this and the previous year, and though merchants do not anticipate a rapid advance in price, they are generally of the opinion that the crisis is practically over. The January stocks for 1908 easily beat all records for the last dozen years or more, and so did the price for fine Para.

During the last twelve years the nearest approach to the market conditions of the past month was in 1902, when the Liverpool stock was little over half that for 1908 and the price ranged from 3s. 2¾d. to 3s. 6½d: that same year the stocks gradually increased and the value declined until a record of 2,448 tons stock and a price of 2s. 11¼d. to 3s. 1d. was reached in June, but after that month stock declined and prices again rose; now, with a stock at Liverpool of 2,300 tons our fine Para is realising 3s. 1½d.—a price which, after all, is comparable to that ruling in previous years, if one allows for the increased demand.

It is true that the average monthly consumption, now over 5,000 tons, is higher than it was in 1902; nevertheless, a stock of 2,300 tons in Liverpool alone is sufficiently large to control the destiny of prices for some little time to come. Supplies have come in as rapidly as in previous years, many buyers are taking proportionately less off the markets, and several factories are not yet again in full swing. The present stocks may, therefore, be liable to a further increase. If such depression can be caused by only 2,300 tons of surplus rubber, what may it be when our planted acreages are in bearing and yielding only from 10,000 to 20,000 extra tons of rubber annually?

Even allowing for a very big decline in the output of wild rubber from Africa and America, it is fairly safe to conclude that the total quantity of raw rubber which will be annually placed on the markets of the world from Eastern plantations alone promises to more than counterbalance the reduction from wild areas. The increased production must be seriously considered by manufacterers and those interested in plantation companies. All parties, we believe, are unanimous in hoping that the crude product will always be available at a reasonable price. The manufacturers feel sure that the high price of a couple of years ago have gone for good, and the producers wish for a steady increase in consumption in order that a fair average price shall rule for their commodity.

Advertising Uses of Rubber.

Despite statements intended to imply the contrary, there is a limit to the consumption of rubber just as there is to any other commodity. The sooner planters fully realize this and agree to check their planting-up programme the better for all concerned. That the limit of consumption of raw rubber has not been reached and that there are vast opportunities for using the manufactured article is patent to everyone. Sooner or later the rubber planters of the Indo-Malayan region and manufacturers in Europe and America will have to systematically advertise their goods. The extent to which planters alone can act in this capacity is clear from the results which the Ceylon Planters' Association have achieved in connection with their tea industry. There is every reason why, in order to stimulate consumption, manufacturers and producers should combine to publicly display the purposes for which rubber can be utilized and the advantages accompanying the use of india-rubber articles. Fine Para rubber is £200 per ton cheaper today than it was twelve months ago and both parties can therefore afford to consider an advertising programme based on mutual interests.—*India Rubber Journal*, Feb. 10.

BRITISH RAW RUBBER PRODUCTION.

The Statistical Abstracts just published enable us to show the official figures relating to the export of raw rubber from the various British Protectorates and Dependencies up to the end of 1906. The information is grouped under each of three divisions adopted in this office—Indo-Malayan, American (including West Indies), and African.

Indo-Malayan Exports.

We have already given the total quantities of rubber exported from Ceylon and Malaya for the year 1907; these have therefore been omitted in the records given below.

INDO-MALAYAN.	QUANTITY.				
	1900. lb.	1902. lb.	1903. lb.	1905. lb.	1906. lb.
British India	862,176	115,920	200,704	625,184	502,768
Ceylon	8,223	21,168	43,568	156,912	414,960
Papua	12,983	6,891	11,200	590	7,446
F. M. S. (without Pahang)	—	166	1,333	239,663	1,028,792
N. Borneo	—	—	123,733	138,800	—
Sarawak	461,866	233,980	221,733	559,200	628,266

INDO-MALAYAN.	VALUE.				
	1900 £	1902 £	1903 £	1905 £	1906 £
British India ..	1[illegible]3,189	9,	23,146	85,475	74,566
Ceylon ..	859	2,624	5,652	37,196	1[illegible]1,836
Papua ..	1,435	927	1,029	67	1,145
F. M. S. ..	—	26	250	54,815	217,651
N. Borneo ..	—	—	7,682	10,121	13,980
Sarawak ..	35,1	14,940	18,366	50,771	62,498

The decline in output from British India will soon be checked when the plantations attain maturity; the export in 1906 was only equal to that from less than 5,000 acres of cultivated land, whereas, as we have previously indicated, there are now from 20,000 to 30,000 acres of land in India planted with rubber trees. From all the countries enumerated above, the exports may be expected to rapidly increase in the coming years.

AFRICAN RUBBER.

The wild rubber areas in British Africa do not appear to be capable of largely increasing their output even under the stimulus of the high prices which ruled throughout 1906. It is a remarkable fact that the rubber exported during 1906 from all the British areas enumerated below is only equal to that obtainable from half the present planted rubber acreage in tho small island of Ceylon. The advantages of plantations instead of wild areas are obviou from this consideration alone.

AFRICAN.	QUANTITY.				
	1900. lb	1902. lb.	1903. lb.	1905. lb.	1906. lb.
Nyasaland	86,404	11,723	4,372	17,280	16,403
Uganda	..	68,626	45,809	42,718	73,191
British East Africa	100,600	..	96,948	144,032	148,624
S. Nigeria	2,251,315	865,834	1,177,8[illegible]3	2,842,831	3434,279
	596,332	151,440	131,311	271,904	
Gold Coast	3,452,440	1,599,974	2,2[illegible]8,981	3,687,778	3,649,668
Sierra Leone	274,624	103,783	106,648	42[illegible],610	240,049
Gambia	..	..	19,551	9,071	10,454

AFRICAN.	VALUE.				
	1900. £	1902. £	1903. £	1905. £	1906. £
Nyasaland	9,332	1,180	426	2,160	3,486
Uganda	—	3,430	2,795	5,696	9,759
British E. Africa	10,060	7,778	10,77[illegible]	18,929	19,944
S. Nigeria	137,289	46,946	61,816	226,387	307,077
	48,239	9,272	15,583	23,248	
Gold Coast	328,156	88,602	196,500	3[illegible]3,774	334,505
Sierra Leone	25,741	8,192	9,258	49,132	30,170
Gambia	—	—	1,544	915	1,084

The low prices now being paid for most of the Landolphia, Clitandra, Carpodinus, and other African vine rubbers will in all probability be instrumental in curtailing the output during this and the coming year, though it still pays to collect and export the rubber from Funtumia elastica trees. Plantation developments are not as advanced in East, Central and West Africa as one might wish, and there is therefore no guarantee that supplies from those areas will be immediately increased to any considerable extent.

The collection of rubber in S. Nigeria is restricted Under Ordinance No. 14 of 1902. In Sierra Leone the exportation of root rubber is now prohibited (from Jan. 1, 1907). The colony and protectorate of Southern Nigeria were placed under the same administration from May 1st, 1906, and tho returns for 1906 are therefore amalgamated.

We learn from one in the service of the African Lakes Corporation, Limited, that there is not likely to be a great deal of rubber put on the market this year from British Central Africa. The Landolphia vine gives very little rubber, and that of inferior quality, owing to the method of preparation adopted being unsatisfactory.

He was of the opinion that British Central Africa would certainly not be a competitor with the East on the rubber market, owing to unfavourable climatic conditionr.

AMERICAN AND WEST INDIAN RUBBERS.

Owing to the scarcity of rubber-yielding trees and vines our areas in tropical America and the West Indies show up poorly when compared with other parts of tropical America or even British Africa.

West Indian and American.	QUANTITY				
	1900 lb.	1902 lb.	1903 lb.	1905 lb.	1906 lb.
Balance	—	—	84	—	—
Jamaica	—	232	—	—	—
Trinidad & Tobago	—	—	—	9,394	1,067
B. Honduras	3,518	30,338	18,[illegible]93	[illegible],111	2[illegible],2[illegible]4
B. Guiana	425,371	540,[illegible]00	531,399	497,829	639,607

West Indian and American.	VALUE.				
	1900. £	1902. £	1903. £	1905. £	1906. £
Bahamas ..	—	—	2	—	—
Jamaica ..	—	22	—	—	—
Trinidad & Tobago	—	—	—	1,221	174
B. Honduras ..	365	2,911	2,165	2,815	3,486
B. Guiana ..	19,58[illegible]	40,637	45,187	41,487	64,120

The returns from West Indian islands for 1906 are particularly poor, and only the establishment of large plantations can effect any material increase from these areas. It is difficult to understand why the West Indian islands have been so backward; latest advices assure us, however, that the growers are at last taking advantage of the advice which has been repeatedly given by the various Botanic Departments, and that there is a prospect of substantial improvement when the few plantations now established reach the productive stage.

The figures given in the tables for India, Nyasaland, Uganda, British E. A., Jamaica, Trinidad, and Tobago, and British Guiana,

are those of the twelvemonth ending March 31st of the following year, i e., the Indian exports shown under the heading 1906 are for the twelvemonth ending March 31st, 1907, and are therefore as nearly up-to-date as possible.

All sums have been converted into sterling at the ruling rates of the years in question. The figures for British Guiana include Balata, but those from the F.M.S., Berneo and Sarawak do not include either gutta-percha or jelutong Ceylon figures may include some re-shipped rubber from the F.M.S., etc.—*India Rubber Journal*, Feb. 10.

RUBBER IN BRAZIL.

Sir,—In reply to your request of 6th February that I shall reply to points raised in your issues of January 30th and February 5th, I wish first to correct an error on a personal point. It was Mr H. A. Wickham—no relation of mine—who was sent out by the Director of Kew in 1876 and 1877 to procure seeds and plants of Hevea in the Para region of Brazil, and who eventually obtained them on the Tapajos river.

Brazilian Rubber will not cease to be harvested when the price falls to 3s., nor even if it falls to 1s. 6d., for this reason—

Practically all rubber from the Amazon and its innumerable tributaries is paid for 18 months before it is received at Para or Manaos, in the shape of goods, and a small amount of cash given to the tappers.

The rivers above Manaos, from which most of the rubber comes, are only open to steamer and steam-launch traffic for certain months of the year, when the rivers are high. And this season is uncertain, as I know to my cost, having been stuck on a sand-bank for 26 days at a time when the river was usually full of water.

Thus, supplies to pay for the rubber now coming to Manaos were bought from July to September, 1906, reached Manaos in October-November of that year, and were sent up the rivers from January to April, when steamers could go up with certainty. The tapping season begins April and May, and continues during the season of low water. The first rubber comes down in November-December, and the bulk of it from February to April. Thus all the rubber coming to Manaos at the present time—and being sold there, hardly any is shipped direct by the producers, at present prices of, say 2s. 9d. per lb.—was paid for to all intents and purposes 18 months ago when the price was 5s. 3d. The rates at which goods were advanced say to the tappers were based on 5s. 3d. price, and debited to the tappers' accounts at that price. The rubber they are now sending down can only be credited to them at the 2s. 9d. price. What the loss is to the big buying firms can hardly be imagined—Dusenchon Wommensen & Co. are believed to buy 10,000 tons yearly !

The average per tapper is about 700 lb. each, though some get as much as one ton, and these tappers take goods usually up to 75 per cent. or 80 per cent. of what they expect to get for their rubber. So, if a man expected to get, say, £140 for his 700 lb. at 5s. 3d., less duty and trade allowance, he would have drawn from £105 to £112 in goods. Now, his rubb gets to Manaos and he is credited with only £70 at 2s. 9d., less duty and trade allowance.

Again, the "proprietor" who has charged £105 to £112 for these goods has paid, say, £65 to £80 for them, and, mark this, has paid at least 1½ per cent. per month interest for his credit. Nearly all "proprietors" are men without capital to speak of, and work on credit, and the rate of interest at Manaos is from 1½ to 3 per cent. per month.

Even at 1½ per cent. per month the 18 months' simple interest on £65 is £17 10s. So the unfortunate proprietor gets £70 worth of rubber in return for an outlay of £82 10s., and this in the most favourable instance. If he has paid £80 for goods and debited the tapper with £112, the tapper is £42 to the bad on the year's working, and the proprietor £31 10s ! And thus on each 700 lb. of rubber, £125 loss per ton.

Mr. R. J. Booth asks whether it pays to collect at 1s. 6d. On this I unhesitatingly contradict flatly the Chairman of the "Brazilian Rubber Trust Ltd." No, it does not, and can not, pay the producer.

But the quantity continues to be exported for the reasons I have given above, because it is paid for 18 months ahead. Also there are numbers of wild natives collecting who do not bring their rubber to hand for two or three years after they get it. There are tons and tons of rubber up some of the rivers that can not be shipped because it was tapped some way back from the river bank and all the males in the district are dead. That rubber will come to hand in time, and Chairmen of Trusts will point to its export as proof that it pays to collect it at 1s. 6d.

It did not pay to sell coffee at 27s., but it was sold; it did not pay to sell Ceylon tea at 3½d., but it was sold.

More so, for the above reasons, in the case of rubber. And this it is that plays into the hands of the bears; they know that supplies will continue to come forward, as before, or even in increased quantities owing to the late boom in price, and so they can continue to scare the bulls.

It will not, however, affect the Ceylon or Malay industry seriously, as we now only produce a negligible quantity. By the time we begin to put into the market enough to affect stocks the rebound from the present slump must inevitably have come about. The Brazilian enterprise with its 40,000 tons cannot go on bearing a loss of £125 per ton. The quantity must fall off to the benefit of the Eastern, and Mexican, cultivated rubber.

I am hoping to visit Ceylon and Malaya in April or May this year.—Yours, &c.

R. W. WICKHAM.

Ebley Court, Stroud, Gloucestershire, Feb. 23.

P.S.—As I am interested in rubber both on one of the highest tributaries of the Amazon and also in the East, mine may possibly be considered "an independent opinion," as desired by Mr. Booth.—Local "Times."

THE CEYLON RUBBER INDUSTRY.

THE "SCOTSMAN" PESSIMISTIC.

Rubber, as an industry, seems to have fallen on bad times, but it may be doubted if it has yet experienced the worst. In the autumn of 1905, when the boom in the promotion of rubber companies was at its height, and new undertakings were being poured out upon the public in a broad stream, a note of warning was sounded in these columns to the effect that, favourable as the prospects of this branch of enterprise appeared to be, there was grave danger of its being overdone. The old-established companies which were then in full swing were in a highly prosperous condition, making immense profits and paying very handsome dividends. There was a steadily growing demand for rubber owing to the general industrial expansion that was taking place throughout the world, and especially in those branches in which rubber enters as an important component of manufacture. Demand was for the moment overtaking supply, and there appeared to be, in the popular imagination, at all events, not only no probability that the output would increase for many years to come to such an extent as would sensibly impair the price, but every likelihood that consumption would go ahead at a much faster rate than production. The then prevalent view was that there was room for all. Most alluring statements were set forth in the prospectuses of the new companies regarding the acreage, climate, the number of trees their respective estates could support; the number of trees actually planted and to be planted, the proportion of them which had reached or were about to reach maturity; the cost of production, the market price of rubber, and the dividends that were to be anticipated on the capital embarked in the business, this last aspect of the case being pointed by references to the dividends paid by old-established companies. These concerns were capitalised on an ambitious basis corresponding to the estimates of the profits, no allowance being made for the long period that must elapse before the great bulk of the trees would begin to yield, nor for the fact that when they should do so the whole position of the rubber market would have undergone a radical change in virtue of the immensely augmented supplies. The shares of the old companies rose to three and four hundred per cent. premium, and those of the new companies were rushed up to more or less giddy heights, both before and after allotment, without much discrimination and regardless of the question of the initial capitalisation. The old concerns had been content with capitals of from ten up to sixty thousand pounds sterling, whereas the new ventures blossomed out with capitals ranging from one hundred up to two hundred thousand pounds or thereabout.

At that time the price of rubber was about 5s. 6d. per lb., and it maintained, on the whole, a wonderfully firm footing, with no serious fluctuations, thanks to the activity of the motor, electrical, and other industries, which flourished greatly up to the end of 1906. In January, 1907, the price went up to about 6s. per lb. Then a turn for the worse began to be manifested. In October the American crisis came, and the price fell in that month to 4s. 3d. per lb., and it is now down to about 2s. 9d. When the price ranged about 5s. 6d. promoters were able to hold forth eloquently on the handsome margin of profit it showed on the basis of 1s. to 1s.6d. per lb. for cost of production, especially as no allowance was made for loss of interest on capital during the years of waiting while the trees were growing. Accompanying the fall in the price of rubber there has been a severe depreciation in the

quotations for the shares. In some cases the decline has been as much as 30 to 50 per cent. as compared with those current in the middle of Oct. last. Moreover, it has to be borne in mind that the market is largely nominal in character, considerable difficulty being encountered when an endeavour is made to realise even moderate amounts of shares.

At the present moment the Antwerp rubber trade is suffering from a severe crisis. According to Brussels journals, extensive sales of rubber were recently made by the Congo Administration at 4 francs per kilo., in comparison with 12 francs in 1906, and the market is being congested in consequence of the immense quantities brought by every incoming boat. This, however, is no exceptional experience. So far as this country is concerned, stocks have been steadily accumulating since 1905. At the close of that year they amounted to 1,562 tons, and at the close of 1907 to 3,268 tons. Apart altogether from Para rubber, there are, it is estimated, over 10,000 tons of "mediums" in stock throughout the world, and the tendency is for the process of accumulation to go on. In 1907 the output of Ceylon increased by forty-four per cent, and that of Malaysia one hundred and twenty-two per cent., as compared with the previous year. Twelve months ago there were above 223,000 acres planted with rubber trees in those two quarters, Borneo and the Dutch East Indies, and today there are 331,000 acres. The world's production of rubber last year is estimated at from sixty-nine to over seventy thousand tons in comparison with sixty-five thousand tons in 1906, and the consumption at about sixty-six thousand tons, or practically the same as in the previous year. There is a marked discrepancy between some of the estimates on this subject and the statistics relating to the stocks in the two periods; but ignoring variations in the calculations there is no difference of opinion on the broad fact that while consumption is stationary or retrograding the output is advancing by leaps and bounds. Taking the case of Ceylon alone, a hundred and fifty thousand acres were planted last year, of which two thousand five hundred acres only were bearing, and it is estimated that in the course of the next six years the acreage will expand at the rate of five thousand acres per annum; the number of bearing acres at the average rate of twenty thousand per annum, and the exports of rubber at the average rate of over one thousand tons per annum. Much the same estimates as the probable output in the course of the next few years are made in regard to other parts of the world. New ground is always being broken. This is natural enough as long as capital finds remunerative employment in the industry, as it is still doing except, of course, in the case of joint stock concerns which are unconscionably over-capitalised, as were most of those which were floated during the boom of 1905. It may be pointed out that the recent depression in the rubber share market has been due, in part at least, to rumours that a process has been discovered for the manufacture of synthetical rubber. Without attaching too much importance to this consideration, the likelihood of such a discovery being made or of some good commercial substitute being found which will answer many of the purposes now fulfilled by natural rubber alone cannot altogether be overlooked. The chief point of practical importance is, however, that accompanying a stationary or waning consumption caused by an all-round restriction of industry, there is an ever-increasing production both of the cultivated and wild product.—*Scotsman*, Feb. 24.

A Letter from Mr. Thomas North Christie.

February 24, 1908.

SIR,—Your timely article on the present position of the rubber producing industry may convey one false impression, viz., that the overstocked market is due to the large plantings in Ceylon and Malaya. That is not so, for their total output for 1907 does not equal 1½ per cent. of the world's production, and for a good many years, although the quantity will go up, as you say, by leaps and bounds, the proportion to the world's total will be small.

The high prices which have ruled for the past three or four years have caused the rubber gatherers of the Amazon and Congo valleys to exploit distant sources of supply, which were unprofitable at previous prices, and will again have become so at today's prices. The position of affairs in America has probably had nearly as much to do with the fall in price as over-production has.—I am, &c.

THOS. NORTH CHRISTIE.

—*The Scotsman*, Feb. 25.

COTTON-GROWING INDUSTRY FOR CEYLON.

It is very encouraging to find that hard-headed men of business, who have looked into the question, consider there is a good prospect of Ceylon developing in the near future a very considerable

cotton-growing industry. When a Manchester house, through its Colombo branch, contemplate the erection of a Cotton-ginning Factory in Colombo (including a 24 horse-power engine and 6 gins to begin with), it is evident that there must be a full expectation of an appreciable local crop of cotton to cope with. Reliable reports, indeed, indicate that the planting of cotton is extending, no doubt, in native gardens; for, after all, in Ceylon as throughout the cotton districts of India, the cultivation is one specially suited to the natives, both the owners of, and labourers on the fields. In past centuries, Ceylon —in the East and North especially—grew a notable quantity of cotton to supply the local spinners, and weavers, and "Batticaloa cotton goods"—towellings and such like—were known and appreciated even by householders in Colombo up to quite a recent date. Well, even now, there are quite a number of "looms" for cotton worked in both the Eastern and Northern Provinces—perhaps, 600 looms in the former and 400 in the latter—and there are a few in the Southern and North-Western Provinces. To keep these working, there must, of course, be a certain quantity of the raw product harvested; but it is, probably, of an inferior quality, except so far as good seed may have been distributed and been utilised. Cotton cultivation is peculiarly adapted in Ceylon to the Tamil districts, and it would be strange if the Tamil people here could not succeed, when once they turn their attention to it, with an industry which prevails so largely in the Tamil districts of Southern India. Cotton has been grown on the black soil of Tinnevelly for more than a thousand years uninterruptedly. No doubt, the cotton-growing experiment in the North-Central Province under the direction of Dr. Willis, and to which Mr. Mee was attached (until he was transferred to the Gangaruwa Experimental Station) must have proved an excellent object-lesson and encouraged cotton-growing among the people of the district, if not of the province.

But we are not today to enter further on the consideration of the present state of the industry; but rather to draw attention to some curious information on the subject which has come into our hands and which is probably quite unknown to the present generation. Among early writers was the well-known Ceylonese naturalist, Dr. Kelaart, who published "Notes on the Cultivation of Cotton in Ceylon" so far back as 1854. This was followed in 1856 by some very practical "Notes" prepared by Mr. J. A. Caley, a thoughtful member of the Public Works Department, stationed at Peradeniya. He gathered his information from a Tinnevelly authority of prolonged experience and without entering into details, we may mention that the yields of clean cotton per acre he gave varied from 100 to 150 lb., but there was 75 per cent. of seed to 25 of cotton. Later on, in 1859, Mr. Caley amplified his information into a "Report" which he had published in Manchester with some thirteen pages of letter-press and two elaborate appendices—one, a sketch map of "the cotton-producing districts of Ceylon" which simply showed "Coffee" as appertaining to the South-West quarter of the island; while "Cotton" (in large letters) is printed from Jaffna to Arugam Bay and has indeed allotted to it more than three-fourths of the area of the island! Mr. Caley drew a number of dotted lines from the interior converging on a series of sea-ports to show how the cotton produce of these respective districts could be conveyed to the coast for shipment. In this way Trincomalee, Batticaloa, Arugam Bay, and Hambantota were in the East and South to represent considerable cotton-growing areas; while on the West and North, Chilaw, Puttalam, Mannar and two ports on the Jaffna Peninsula were similarly favoured. In addition to this sketch-map, Mr. Caley provided a very elaborate table, in map form, "showing the cotton-growing districts in the island of Ceylon"; and here the Western and Central Provinces are tabulated as well as the Northern, Eastern, Southern and North-Western Provinces. We must reserve an analysis of the table for another issue, merely remarking how that one column "showed principal places (in each native division) where cotton is grown" and another "the principal places where spun and woven"; while no fewer than eight additional headings are devoted to "quantity grown," and questions connected with the cultivation, soil, value of crop, &c. It may be inferred from this that fifty years ago "Cotton" was taken very seriously by some Ceylon authorities as a native industry which ought to grow more and more into importance.

THE WATTLE INDUSTRY IN NATAL:

WHY NOT IN CEYLON?

A wattle-growing and tanning-bark industry for Ceylon is an old subject of discussion in our columns. We have published a prize essay

with estimates of expenditure and receipts by a practical planter; but no one has yet led the way with a regular plantation or clearing. We think Government might well give a free grant of land and some other privileges to the man who guaranteed the planting, cultivating and cropping of at least 100 acres. In Natal 1888 is given as the date of the first cultivation there of the black wattle of Australia, and now we see that the area covered with it was 80,762 acres in 1906 with a steady extension last year "Wattle bark" has consequently attained to the third place in the list of Natal's exports to over-sea countries. The return begins five years after planting and it is found in Natal that no amount of cutting interferes with the life of a tree which is regarded as perennial. The export of bark rose to 35,537 tons in 1902 and the value of the export was from £90,000 to £100,000 for three years 1904-5-6. For the ten months ending with October, 1907, it rose to £125,000—or Rupees 1,875,000—quite a respectable amount. We are told that the trees are felled and stripped of their bark gradually after they are five years old: complete felling can take place after ten years. So far the average yield is half-a-ton per acre per annum. The cutting must take place when the sap is up and the bark is then stripped from the entire tree, extending to all branches of 2 inches diameter. The bark is then dried in large sheds or often, if fine, in the open. After 20 to 25 days of drying, it is cut, ground or shredded into small bits and packed in bags of 200 lb. each. Germany, Russia, Austria and Belgium are customers as well as the United Kingdom. Now, it is quite possible that Natal has special advantages in soil, &c., over Ceylon: the analysis of Natal wattle bark shows as much as 40 per cent of tannin; and clearly it may pay better here to deal in other products since there is a waiting of five years. Rubber, of course, would seem to be far more attractive; but there is a limit to the zone of rubber and it is just far above that zone that the wattle grows here. It may be again that camphor is the more profitable venture at a high elevation. That remains to be seen, and there is a good deal of talk in Germany and America about "synthetic camphor." So that we do not think that a black-wattle tanning bark industry should be altogether forgotten or despised. It may be found in years to come a useful "second string" to either camphor or high-grown tea —who knows?

EXPORT OF CAMPHOR SEED FROM JAPAN MAY BE STOPPED.

A PROPOSED GOVERNMENT MONOPOLY.

In the course of a business letter to us, Mr. S. Idia, Manager of the Yokohama Nursery Co., Ld., states that the Japanese Government contemplate creating a monopoly of the camphor seed trade; or they may, before long, stop exportation of camphor seed altogether. The authorites have already cautioned firms engaged in the seed trade against exporting large quantities; and this our correspondent regards as "a very mean and narrow view unworthy of the Imperial Government." "When your planters fail in raising camphor seed in Ceylon," he continues, "they attribute their failure to our poisoning the seeds before we export them in order to prevent germination. As seedsmen no one has any interest in doing such a trick: it is to their interest to deal honestly and see the species they sell propagated in other countries." In this connection the latest information regarding the Formosan camphor industry and the steps being taken by the Japanese Government to retain its pre-eminence will be of interest. In the *Japan Times* (February 29th) just to hand, we find the following statement from that journal's commercial correspondent:—

The total output of camphor and camphor oil during the current fiscal year up to the end of January reached 3,339,000 and 3,538,000 kin respectively. The Government income from this monopoly source amounted to 7,118,451 yen indicating an increase of 813 868 yen over the estimation which stood at 6,205,583 yen. Compared with the actual receipt of the 38th fiscal year, which was 4,865,226 yen the figure shows a great increase of 2,254,225 yen. So abundant was the amount of output that in spite of the slump during last year a good income was experienced. Since the camphor industry was monopolized by the Government several years ago it has made conspicuous development. At present the world yearly consumes about 8 million kin of which Japan supplies some 5 million kin the rest being supplied by the production from Ceylon, Canada, Florida and South China. So far there seems to be nothing to be regretted with regard to the industry. But the trouble is that recently along with the development of manufacture the stock of raw materials, namely, camphor trees, is fast growing scarce so that if the situation continues it is feared they will hardly stand the coming 15 years' supply. Under

the circumstances the authorities have devised a plan to collect camphor from the leaves of the camphor tree as relief means and in the meanwhile are urging the local cultivators to plant young trees on plantations of 30 square cho every year in each prefecture. In Formosa the Governor-General is making efforts for the extension of the camphor cultivation carrying on the plantation of trees by way of setting an example and encouraging the natives to take to the cultivation by leasing land belonging to the Government. An extensive plantation is established at Taito on leased land by Mr. Tsuchikura of Yamato and another by the Mitsui Firm. With the farther advance of the Aiyu line the authorities are going to carry out plantation on a grander scale by encouraging the inhabitants to engage in the cultivation. The authorities will establish a special training institution for training camphor makers. These measures if carried out give a flourishing finish to this monopoly industry in which Formosa has no rival in the world's camphor business. The experts who were despatched last year to South China for inspection of the camphor industry there are expected to be back this spring and on their return the authorities will start investigation as to the proper measures to provide against the rival industry.

TO RENOVATE AN ORANGE TREE.

Many an old tree is permanently lost to the cultivator the life of which could be much prolonged by judicious and careful treatment. An old tree which has been neglected generally carries a top or head consisting of large branches on which the bearing wood is stunted, the leaves small, and what fruit it bears probably not more than half the original size it produced when in its prime. To begin work, the cultivator should carefully remove the surface soil from about its roots to a depth of six to eight inches, little by little, taking care not to cut or injure the roots in so doing, but to carefully preserve all that are seen. If the work is done in hot weather the bared roots should be kept carefully covered from the sun while the operation of removing the soil progresses. The soil removed is to be heaped neatly on one side for after-use. The distance from the tree to the fullest extent of its roots may be gauged by the spread of its branches, and the soil should be removed to the circumference of the circle over which its branches spread. If the trees are planted in pasture where the turf is good this should be removed in sections that can be conveniently replaced. Procure some well rotted stable manure and place a liberal application of some four inches in thickness over the bared roots using a little of the soil to cover the roots, so as not to place the manure directly upon them. Having placed the manure, return the soil and cover the manure, finishing finally with replacing the turf. If dry weather prevails give regular waterings two or three times a week. Manure should not be placed nearer the stem than about 2 feet, as there are few or no roots within that distance, and manure is sure to do harm to the bark of the stem and the stem of the main roots. Watch the tree and take note when young shoots begin to start and when these—which should be plentiful—have grown to about a foot in length, shorten back the branches of the whole head carefully with a saw, to points from which the new growths have started cutting well back, but leaving the head or top as a whole of a rounded or well shaped form. No branch should be left longer than the rest, but all should come within the general contour lines of the head taking especial care *not to leave* the upright branches longer than literal or spreading ones, as *sap always flows most quickly to the highest point* (a general axiom), and if the upright central branches are left too long, they will invariably take away sap and nutriment which is wanted in the literal branches. As the young shoots extend in growth, great care should be taken not to let one get ahead of another, and if such growth appears it should be "stopped" by pinching out the points with the thumb and finger while the wood is soft. By such a method many a tree may be rejuvenated and made to bear good crops of excellent fruit for years afterwards, but it sometimes happens, that the vitality is too far gone, and the result will then be the death of the tree. As a rule, however, the practice is worth while in any case, for it probably would have succumbed, if left in its original state. The practice here described is not limited to the orange tree, but may be used with advantage on Fruit trees of all kinds, and sometimes is useful for trees of an ornamental character.

In dressing orange trees for insect and some forms of Fungal diseases, the head of the tree may be safely cut away down to the main branches carefully with a saw, entirely denuding it of leaves. The branches and stem should then be carefully washed and scrubbed, and a mixture of soft-soap, tobacco water, sulphur and clay mixed to the consistency of paint, applied

over the whole surface of stem and branches. The young growths will soon start through this coating and as they show they should be thinned out to make a uniform head not too closely crowded with branches. In this way pests may be got rid of which can be disposed of by no other method.

The practice is merely a variation of the old English method of winter dressing of orchard and hot house fruit trees, which has been practised with better effect than many of the newer formulas when fighting insect and Fungal attack.

An orange tree cultivated in the Gardens has, after treatment of this kind, given larger and finer fruit than it has done for many years in the same year in which the operation was performed. Visitors are invited to inspect it.—*Trinidad Bulletin*, for Jan.

MR. J. H. RENTON AND THE CONTINENTAL CAMPAIGN.

"Mr. J. H. Renton was in the city to-day (February 14th), calling on Ceylon friends," writes a correspondent. "He is, I hear, busy with his report on 1907—on the work done in the Ceylon Continental Tea Campaign. The French import returns, he says, will not be ready till November next; but the work in France has been comparatively disappointing. The propaganda carried on with Ceylon money has been turned to account by the purveyors of Annamese tea. 273,000 kilos of the latter were cleared for consumption in 1906 against 100,000 kilos in 1905—showing 170 per cent. advance! But on the other hand much Annamese tea—the poorer stuff, that is—has been sold as "Ceylon"; so that when Mr. Renton approaches firms to take up Ceylon, they have said 'Look at this. Cannot drink it. We don't want your Ceylons.' And when they are told it is Annamese they say simply: 'Well, we bought it as Ceylon. And we don't want any more Ceylon.' Ceylon has thus been made to suffer in France for the poor tea of a French Colony.

"In Germany, however, the returns of which for 1907 are already out, your readers will be glad to know Mr. Renton finds the *only producing* countries which show an increased consumption are India and Ceylon.

"The next project in hand whereby to make Ceylon tea known is the Bavarian Exhibition at Munich, for which town Mr. Renton leaves next week. Bad luck has attended Ceylon here, for the Mr. Volcker who had the concession for a tea room—a gentleman related to the Surgeon of the Regent of Bavaria and otherwise well-connected—has just died by the bursting of a blood-vessel (surviving ten hours only). As some difficulty had been experienced in opposition to the big firm which holds monopoly for the coffee, &c., sold at the Great Eastern Munich station, in making secure the concession obtained by this enterprising merchant, Mr. Renton is to be commisserated with on the increased work which will fall upon him to see that the interests of Ceylon tea do not suffer.

"Rubber manufacturers on the Continent, Mr. Renton says, have had a great set-back lately owing to decreased orders and requests to hold back orders already given. In England it is owing to heavy stocks at Liverpool chiefly that the price is so near 3*s.* for wild Para just now. But with easier money, orders for motor tyres should increase shortly and manufacturers become busy again."

TEA, RUBBER, AND LABOUR.

OPINIONS OF MR. G. A. TALBOT, V. A.

FALL IN RUBBER A GOOD OMEN!

NO APPREHENSIONS ON ACCOUNT OF "CHINA TEAS."

The opinion of Mr. G. A. Talbot, the well-known V. A. and Director of the Ceylon Tea Plantations Coy., Ltd., on Ceylon planting subjects is always worthy of attention, for Mr. Talbot is one of the best known and busiest of men in Eastern planting circles in London, being Director of no less than thirteen planting Companies operating in this Colony, F. M. S., Java, South India, &c. This morning an *Observer* representative buttonholed him in the "G.O.H."

"Tea?" said he. "Well, it is today better cultivated, and shows the effects of better cultivation, than ever I knew it. The statistical situation is good and we have no reason to expect a fall in prices.

"The China trade in England need cause no apprehension. When sudden 'rises' take place no doubt inferior teas, such as China sends out, are used in blending, but not permanently. Interested people and Doctors periodically lay a snare for us by strongly recommending 'Chinas' in England, and, of course, importers make as much capital out of this as possible, and confirm the need of an organisation to combat it and make known amongst the public what are the merits of 'Ceylons,' and the demerits of 'Chinas.' Beyond this, however planters need have no fears, I think.'

Rubber Hopeful.

"Regarding rubber, my opinion is that the recent fall in the market was a very good thing for Ceylon generally, because, only a small proportion of planted land being in bearing, it is better for the island that there should now be this check on development, and a steadying of the market, than that it should be later when we have so much more material being produced. The present fall in the market will, in the course of the next few years,

Lessen the Supplies from Brazil,

and probably knock out altogether the production of the inferior rubbers that have lately been collected in Africa."

THE LABOUR FORCE.

"So far as our labour force is concerned, I think we are very well supplied with coolies. There is certainly some anxiety on the part of Superintendents, chiefly in the neighbourhood of large bazaars as to whether their coolies will be 'shifted'—whether, owing to their indebtedness to the bazaar-keepers, the coolies will be forced to leave in order to raise money to pay off their debts. As regards

Higher Advances Providing the Inducements to Leave

no doubt employers will give premiums in order to get necessary work done in a certain time. It is purely a business matter, and it is quite useless to try and prevent it. You cannot prevent it, in fact. The evil of it lies in this premium being given, as now, in the shape of coast advances, which kanganies and coolies nominally have to repay. In some cases, no doubt, the coolies' pay is actually taken to repay these advances, which has an entirely demoralising effect on the labour force. The cooly, with very high advances, becomes either a debtor for the rest of his life and has, therefore, no encouragement to work, or he becomes a defaulter. If this state of things were to continue, or increase, our labour force, which, I may say, is the finest in the world, at present, would be seriously injured.

"Of the future of labour, we are now awaiting the sitting of the Commission, which will, no doubt, recommend rules, or laws, which will

impose more obligations on the employer,

such as regular work, and, perhaps, the cost of recruiting. In this event, I think the employers of coolies, on their part, should in return demand some legislation to prevent the cooly becoming indebted, or liable to be sued for more than a certain amount, say R15. Such a limitation of liability would do away with the demoralising effect of high advances, and would necessitate any premium that had to be paid being given as a bonus, or in some other form.

"I hear that the Forbes-Bliss scheme has been approved not only by the Kandy Association, but by several others. Whether it will succeed or not

depends upon how it is conducted by the planters

generally. I will not say anything further upon the scheme while we see it in its present position of development."

TEA DISTRIBUTOR ON THE TRADE OUTLOOK.

The views of the tea distributor, whether wholesale or retail, and his views of the trade outlook are not without interest for the tea grower. Mr. F. J. Tregilas, lecturing on tea to the Midland Council of Grocers' Associations last week, and discussing the question of the price of tea, said: "Taking the position as a whole, there seemed every probability that the depression that had ruled for many years had at length passed away, for production had shown little increase during the past twelve months, while consumption both at home and abroad had materially increased, and very little additional land was being placed under tea cultivation. In 1890 the consumption of British-grown tea outside the United Kingdom was 14,000,000 lb.; this increased to 130,000,000 lb. in 1905, and over 171,000,000 lb. last year. The very rapid increase lately might be attributed to two reasons. First, the scarcity of common China tea, owing to the low prices that ruled for several years not being remunerative to the importers, and, secondly, the too exceptionally low prices for Indian and Ceylon teas, because of very large crops. Experience showed that once Indian and Ceylon teas were used instead of China they were never given up. The world's consumption of tea had now overtaken the supply, a certain amount more could doubtless be produced, but the demand abroad would most likely exceed this quantity, and it must not be forgotten that wherever new ground was planted, it took five or six years to bring the tea bush into full bearing. We should probably get a larger supply of common tea from China next season, but that was an uncertain quantity, and was not liked by the British

public. Regarding the position from all points, it looked as if for several years we should not see the low prices to which we had been accustomed. Grocers were getting a smaller profit on their low-price canister, and many of them were in consequence endeavouring to make up for this by giving less for their better tea. Surely they would do better to keep up the character of their higher blends, and endeavour to increase their sale for good tea, instead of decreasing it by giving inferior quality. It might be advisable to stock low-priced canisters—in fact, it was necessary in some neighbourhoods—but it never paid to show them. Common tea, as shown, was not economical, as the leaf was coarse and flat with little sap, consequently taking much more to make a cup of equal strength, with that brewed from young leaf and higher grade. The grocer could gain neither profit nor reputation by cutting retail prices in low tea, so that after all the big advance of the last twelve months might ultimately benefit him. Under present conditions it seemed to him that what the grocer wanted to do was to force attention to the better value and greater economy of good tea—*i.e.*, tea at 2s. per lb. as compared with lower grades. He should like to see enterprising grocers driving this fact home. They could never permanently satisfy their customers with common tea, and after twenty-five years of experience in the trade he might say that he had seldom met a grocer who had constantly maintained the quality of his best canister, and kept it constantly before the public, who had not held his trade in the present day of keen competition. Unfortunately, the grocers who did this were decreasing in number."—*H & C Mail*, Feb. 21.

HEVEA AND CASTILLOA.

Castilloa Outgrown.

In July, 1898, a small experiment plot was planted with Hevea and Castilloa mixed, the trees of each kind being the same age. The growth of Hevea has been such as to compel the removal of the Castilloa to give them room. In fact the Hevea had outgrown Castilloa to such an extent as to completely dwarf them. The trial therefore decides that Hevea, on the St. Clair lands, will outgrow Castilloa completely, all conditions being equal. This growth of Hevea cannot be attributed to preponderating numbers, as the trees of Castilloa outnumbered them by two-thirds, and for the first two years outgrew Hevea.

The land on which the trees were planted was evidently not so well suited to Castilloa as to Hevea, and the latter in consequence made most progress. It is a well-drained sandy alluvial deposit, but scantily charged with organic matter. The experiment therefore shews not only that Hevea will outgrow Castilloa, but that it can outgrow it on lands which are stated by some recent writers to be utterly unsuited for the growth of Para Rubber, who maintain that Hevea cannot be grown to advantage anywhere but in the damp and dismal swamps of the Amazon and kindred localities.—*Trinidad Bulletin* for Jan.

DEAD OR DISEASED COCONUT TREES.

New Regulations.

The following are promulgated in the *Government Gazette* in substitution of the regulations published in the *Gazette* of 3rd January last :—

1. It shall be the duty of the owner or person in charge of every coconut tree which is dead to forthwith uproot such tree and either to consume it with fire or to keep it completely submerged in water so that the beetle and all eggs and larvæ thereof may be totally destroyed, and that the tree may not serve as a breeding place for any or either of the beetles mentioned in the schedule to Proclamation dated December 18, 1907.

2. It shall be the duty of the owner or person in charge of every living coconut tree which is attacked by the beetle secondly described in the said schedule either completely to destroy the tree in one or the other manners described in section 1 of these regulations, or to cut out and destroy the portion of the tree that is attacked, together with all the contained beetles and their eggs and larvæ, and to fill up the cavity with mortar or any other material that will prevent the re-entry of such beetles.

3. No owner or person in charge of any land or premises shall keep or permit to be kept on such land or premises dead coconut stems or pieces of coconut stems (except such as have been sawn or split into rafters for building purposes) or other matter which would be likely to harbour or become breeding places for the said beetles, or neglect or refuse to remove or destroy the same when required so to do by a notice in writing signed by the Government Agent of the Province, or the Assistant Government Agent of the District, or any Police Officer or Headman.

4. No owner or person in charge of any land or premises shall retain on such premises rubbish heaps or other accumulations of dung or vegetable refuse required for manurial purposes for a longer period than four months before application.

5. The Government Agent, Assistant Government Agent, and every Police Officer and Headman shall have access at all reasonable times into and upon any land whereon any coconut tree is growing for the purpose of inspecting such tree, and also into and upon any land or premises where there is reason to suppose that there are kept any such things as in the preceding rule are referred to.

THE LECTURE ON COCONUT STEM DISEASE AND NEWSPAPER CRITICISM.

It is only now that I have the time to offer a few remarks on the very instructive lecture on the above subject, delivered by Mr. Petch at the Public Hall at the instance of the Low-country Products Association.

I think Mr. Petch would have been well-advised, if he had avoided the undignified expedient of trying to refute in his lecture all the newspaper criticisms levelled against him owing to the not satisfactorily-explained delay in combating the disease since it was brought to his notice in May, 1906. It was very proper for him to show up all the quack remedies suggested by those, who, to advertise themselves, give expression to all manner of crude ideas as to the cause of the disease and how it is to be overcome, and with a courage that cannot but extort admiration write above their own names.

Mr. Petch details at great length how he cultivated the fungus which produces the bleeding disease, and how he innoculated certain trees and successfully infected them. The most that all this proves is, that it is possible to artificially infect trees with the fungus. That the hard bark of coconut trees could be successfully infected by the bleeding stuff being carried from tree to tree by human beings and animals, is so far surmised pure and simple, for Mr. Petch himself says in his lecture that the system of innoculation he practised "is the normal method and the only one that will give reliable results. To attempt to imitate nature by bursting the spores on the exterior of a tree is absolutely worthless." Mr. Petch says that his "object is to prove that the disease is infectious, and to do that the innoculation must be made under the most favourable conditions." Precisely so. That is all we can admit, that it is possible to infect coconut trees under the "most favourable conditions" of innoculation.

Mr. Petch states that he was surprised to find a coconut estate where the fallen fronds and husks were burnt, and it was the first clean coconut estate he had seen. All well cultivated coconut estates—and their name is legion—burn all the fallen fronds at the periodic weedings, usually every two months after every crop is picked. Some estates burn all the husks, some use them to protect supply plants from the attacks of cattle, and others use them for manufacture. There is only one estate I know of where the fronds are collected and burnt as they fall. That is possible there because the coconuts are in isolated "topes" of limited extent, with a watcher in charge of each "tope" whose duty it is to collect and burn the fronds as they fall.

I am not a member of Katana Agricultural Society, but a prominent member of it told me with much indignation, that no notice was taken of their representation by the Peradeniya authorities, till the late Mr. Jardine took up the matter. Mr. Petch claims the treatment he suggested in 1906 as all his own. Ordinary readers must be pardoned if they thought otherwise after reading his paper in the December number of the "Tropical Agriculturist." After describing the places where he saw the disease, and the opinions of leading coconut planters on it, he writes :—"The following measures were tried several years ago." Now this was written in December, 1906, a few months after the disease attracted attention. The conclusion is legitimate that what was tried (not *I* tried) several years ago, that is before the attention of Mr. Petch was drawn to the disease, were the measures of some one other than Mr. Petch.

"Much of the criticism arises from a misconception of the duties of a Mycologist. . . . Some people seem to think that the Mycologist will go down and carry out the actual treatment. If your Medical Officer of Health advises that certain drains should be cleaned out, you do not expect him to come and do the work." Certainly not. We expect him to *see* that the work is done and not to content himself with the mere suggestion. The Government thinks so too, for Mr. Petch announced later on that a band of Inspectors was to work under his orders.

In reply to Mr. Ferguson, Mr. Petch is reported to have said that, in his opinion, the disease is not spreading, only that more attention is paid to it now, hence the discovery of large numbers of affected trees. A rash statement this for a Scientist. Every practical planter, who has paid attention to the disease, will assert the contrary and that every round his men take of the estate, new trees are discovered with the disease and new disease patches are found on the trees treated previously. In 1906 I could not discover one single diseased tree on the estate I am writing from, though I looked out for the disease carefully. Now thousands of trees are affected.

As I stated often, the disease is practically harmless on old trees with hard wood, but is very serious on young plantations.

The pace the Government adopts to stamp out the disease in the native holdings is not one that kills. I wonder whether even one Inspector has been sent out. B.

THE COCONUT PALM STEM DISEASE AND ITS TREATMENT.

Action of the Pests Board: 75,000 Notices Required for Colombo.

March 10th.

Sir,—The Low-country Products Association has begun well, in the practical step which it took to inform its members, and all interested in the Coconut Industry—and how few in the country are not?—of the danger which threatens the industry. And it is also to be congratulated on the measure of success which attended its efforts last Friday. The information, which Mr Petch supplied in his lecture, was most valuable; and although much of it had previously seen the light, in letters and in imperfectly reported demonstrations, it is not easy to overdo instruction on a vital matter. Through the willing help of the Press, everything that science, so far, has ascertained about the disease, and can recommend in its treatment, is now before the public. And more, the questions with which Mr Petch was plied, while they helped to elicit much useful and definite information, supplementary to what the lecture contained, also helped to dispel some delusions and superstitions to which some people had been clinging. Surgery is not a popular science; and the owners of coconut estates and gardens would much sooner believe that the disease could be overcome medically—through applications to the roots or to the bark—than by excision. But it is occasionally necessary to sacrifice a limb to save human life; and Mr Petch was very clear that nothing that the tree could absorb by the roots could possibly arrest the growth of the fungus within the bark, and no outward application to the bark could reach the fungus within the wood. But there is such a thing as conservative surgery—conservative, not only in the sense of saving life, but in the sense of saving the affected part or limb. The suggestion that carbolic acid might arrest the growth of the fungus seemed to find some favour with Mr Petch; and although its application cannot wholly dispense with excision, it is for intelligent land-owners and Superintendents to test the efficacy of the acid by painting with it the wood, after cutting out only as much as is decayed. At present all the discoloured wood is cut out, as there might be a thread of the disease running within. Would carbolic acid or the vapour or fumes of some other substance reach the fungus and arrest its growth? The importance of an answer to this question cannot be exaggerated, not merely as a means of saving time and money in treatment. The immense weight of the head of a coconut tree is well-known; cultivation adds to its weight; and the effect of cutting out two or three inches of the stem, especially above its middle, is to weaken its powers of resistance against wind considerably. I have had more than one healthy clean-stemmed tree snapped in the middle by a high wind. The risks of such mishaps have been greatly increased since the cutting out of the stem has had to be resorted to. I feel sure Mr. Petch will carefully investigate the possibility of conservative treatment since the matter was brought to his notice last Friday. I am trying it myself here, but the practical planter can be materially aided by scientists, especially through the suggestion of suitable substances for experiments. Pending these experiments, the heroic treatment must go on; and it is there that the coconut industry is almost wholly dependent on the Government. The more intelligent classes may be trusted to act from self-interest at least—though not a few events of them are too old-fashioned or self-sufficient to accept Western ideas; but there is the vast mass of the peasantry. It is not only that their inaction must seriously jeopardise the interests of their progressive neighbours; but they themselves stand to be ruined. The Government cannot possibly allow nine-tenths of the population to be impoverished, and reduced to want, by the destruction of one of their main sources of wealth and even of subsistence. Only those who live among the people can form any conception of the dependence of the Sinhalese villager on his coconut trees; and the Tamil or Moorish villager is scarcely less dependent on this most useful palm. The Government has proclaimed the stem disease a pest, but the villager has as much to do with the *Gazette* as with the man in the moon. The Plant Pests Board for the Western Province had a long sitting at the Colombo Kachcheri on the 3rd instant, under the presidency of Mr Booth, and decided to have notices printed in Sinhalese, containing the Government notification and the suggested treatment with a warning that neglect to carry out the treatment is an offence punishable by fine and imprisonment and will result in the treatment being carried out at the cost of the occupier or land-owner by special officers. The number of householders in the Colombo district being 75,000, that number of notices has to be printed. Each village Headman is to be required to write the name of each owner of coconut trees in the village on a notice and serve it on him and make a return to the Government Agent. The Government is to be asked to hurry on the printing—official formalities take time; and meanwhile all village Headmen are to be asked to make known to the villagers beforehand what is expected of them.

The mention of these formalities and requirements justifies a short reference to the personal aspect of Mr Petch's lecture. There can be no doubt that there has been some wild and heated writing about the neglect of the Peradeniya authorities; and Mr Petch's irritation is, to some extent, natural. But the precedent of delays in the Godaveri delta is not one we should care to follow here. We have no explanation of the causes of delay there; and Ceylon is a much smaller place than India. A letter or an article in the *Tropical Agriculturist* is not notice to the Ceylon public. If Mr Petch had no idea in December, 1906, of the seriousness of the stem disease, the unscientific planter could scarcely be expected to have realised its seriousness. If he did regard its seriousness aright, should he not have pressed on the Government, the gravity of the situation? Even

if 18 months was not too long a time for the definite ascertainment of the character of the fungus and its mode of propagation, it does seem too long a time for allowing the disease to be combated only by ardent readers of the *Tropical Agriculturist.*—Yours truly,

F. B.

P.S.—After concluding the above, I looked up Mr. Petch's article in the *Agricultural Magazine* for December, 1906—an article which had escaped my attention—and find that the disease "was first brought to the notice of the Department in 1903; but no information was left on record." His own attention was called to it "last year," 1905 through the *Observer*. "In the early part of this year (1906) information to the same effect reached Peradeniya from several sources." The particular locality was visited, presumably in May, 1906. "Inoculations from pure cultures were made in October, 1907, and proved successful in January, 1908." So that it took 4 to 5 years before the Department ascertained definitely the name and nature of the fungus. I say the Department, because we have not to do with individuals who are directly responsible to the Government. That period must strike the uninstructed public as rather too long for a definite investigation; and even the Government may admit that it goes beyond the pace which it recognises as usual unofficial circumlocution. But the treatment was prescribed in 1906. That is clear, but no one reading the article, and its reference to "the fungus which is supposed to be the cause of the disease," and to the inoculations then made at Peradeniya, to the doubt "whether the infection has been successful," would understand that a final decision had been arrived at as to treatment. Whether so, or not, neither the public, as distinguished from the Agricultural Society, nor the Government was warned of the seriousness of the trouble.—F. B.

THE COCONUT PALM AND ITS ENEMIES:—A NEW BEETLE PEST IN THE SOUTH SEAS.

We are much indebted to an old Ceylon planter and friend—Mr. Frederick Wernham—now of the staff of "Lever's Pacific Plantations, Limited," for his very useful and informing letter on a new beetle pest which is giving trouble on some of the Pacific islands. So far, we may take it—on the high authority of Mr. E. E. Green (who is at present in Europe on furlough)—that it has not been seen in Ceylon? But it behoves all of our intelligent coconut cultivators to be on the alert and to notify should anything corresponding to Mr. Wernham's description, come under their notice.

Sydney, March 17th.

Dear Sir,—An insect pest to coconuts has been brought to my knowledge of late. Mr E E Green, Ceylon's Government Entomologist, to whom I wrote some time ago, on the subject, and sent specimens, told me that the insect is not known in the Indian region. I write now, as by bringing the pest to the notice of your many readers in other parts of the tropics where the coconut tree flourishes, it may be, some may have knowledge of it and will inform us what steps are taken to rid the coconut trees of the insect.

The pest in question is a small beetle the *Brontispa Frogatti* one of the hispid variety, which, I believe, was first sent from New Britain to Mr Frogatt, the N.S.W. Government Entomologist and identified by him. The beetle measures about 7-16 of an inch in length, is narrow and flat. It has a black body and red head. It makes an entry into the bud of the coconut tree, more particularly when the trees are young, and breeds inside the fold of the fronds of the unopened leaf. Its young is a small white grub. They feed on the fronds, which, when the leaf opens, show brown patches on them, or if the beetle is in any number the whole leaf may be withered and in wet weather gets soft and pulpy. So soon, or soon after the bud bursts, the insects recede downwards and take up their home in the following bud and if no means are taken to eradicate the pest, each succeeding leaf is more severely damaged and the plant quickly assumes a withered and stunted appearance. Unless carefully watched the pest may get a big hold on an estate, before it is very noticeable, as the insect breeds very rapidly.

It has been traced and would seem to come originally from different palms in the jungle, more particularly the Areca palm, but to these the beetle never seems to do nearly so much damage as to the coconut tree. This is probably due to the centre bud of the former being very much harder and coarser than the bud of the coconut tree. The insect breeds all the year round, more rapidly perhaps during the wet season and may be found in all different stages of development in the same plant.

Different means to eradicate the pest have been tried, but so far, that which has proved the most successful is a spray made of a mixture of Sunlight soap and tobacco and applied by means of a bottle with cork and quill in it, like a bitters-bottle. Some plantors have got very good results from periodically dusting a handful of fine dry ashes into the centre of the tree, but it seems to me that, to be successful with this, requires a dry climate, or rather that ashes give the best results in dry weather. It has been remarked that the beetle is not found in plants, in which small red ants are plentiful and that some times it is covered with small parasites. Whether these have any harmful effect on the beetles, is not yet known.—Yours faithfully,

FRED WERNHAM.

SALT FOR COCONUT PALMS.

March 27th.

Dear Sir,—Did not Mr. Petch at his recent meeting with the Locountry P.A. state that, in the Philippines, the Americans had demonstrated that "salt" was deleterious rather than beneficial to coconut palms? Now are there not experienced planters in Ceylon, who have also tried the experiment with a different result?—Yours,

COCO-PALM.

[The late Mr. R. Davidson was a very ex-

perienced coconut planter and this is what he wrote in 1861 :—

"The planter of coconuts can point to experience and say that whether science in general, and chemical analysis in particular, be for or against him, Salt is the manure which he *must* have. The late Dr. Gardner* used to describe the value attached, in the Brazils, to salt as a manure for Coconuts, stating that a man would walk many miles for it, pay high for a load, and then apply it to a single tree. At Singapore the ashes of a plant, rich in salt, are used with extraordinary results—and I think that at Batticaloa the ashes of the mandrake are from the same cause, those which produce the most effect. Here, day after day, may be seen strings of carts, creeping from the beach to the estates, laden with sea-weed—which, experience has proved so useful as a manure. For the sake of the salt it contains, (22·25 per cent in the ash), we drive a cart load of mattor which we could obtain (if required) much nearer, and at a tithe of the cost, because our rulers persistently refuse to allow us *at the price they sell it for exportation*, to purchase that salt for our estates, which it sometimes *costs hundreds of pounds* to destroy. I know not what has been done elsewhere in the hope of getting it, for agricultural purposes, at a reduced rate ; but it may be useful to show that the planters of the Northern Province have done their utmost. I think I am right, (I write from memory) in saying that the following offer was made to Government. Parties, to get salt at export price, would adulterate it, with tar water or any other matter best adapted to render it unfit for ordinary purposes, in the Government stores. Before removing it they would enter into a penalty bond, to the full value of the salt, at the market price, that it should be used solely as manure for coconut trees, and they would pay for a Government employee who should certify to its application as specified. This offer, like every other, was refused. About a month ago petition for salt at reduced rates was refused on the ground that if given at reduced rates for agricultural purposes, it must be given at the same rate to fish curers, &c. The fallacy of this reasoning is apparent if we consider, that it places the producer and manufacturer in the same category; and applies to them in common a principle acting differently on each. We deserve, perhaps, that our wants should be disregarded ; for I do not remember that coconut planters have ever combined to have them fairly represented. With more of unity and combination in our efforts we should doubtless command success."

[This is a matter which should be looked into by the Lowcountry Products A.—Ed.]

SALT FOR COCONUTS.—This is what Dr. Butler says in his Report on Travancore :—"It is said also to flourish best sufficiently near the sea to allow of the sub-soil being infiltrated with sea water. Different analyses in India, Ceylon, and the Philippine Islands seem to show that a heavy crop removes over a hundred pounds of potash salts and over sixty of sodium chloride (common salt) per acre per annum, and may explain this preference. Be that as it may, a large proportion of the best Travancore coconuts are in soil which is infiltrated with salt or brackish water. That this salt is a necessity to the tree is evidently believed in many coconut growing countries where, as in Travancore, an application of salt to its roots is frequently made. Its requirements in potash and magnesium are probably supplied in part by infiltrated sea-water in low-lying littoral or backwater soils. Elsewhere they are furnished by dressings of wood and leaf ashes (largely of the coconut itself) applied around the base of the tree. Beyond this a limited amount of manuring with coconut or other poonac, cattle manure, fish manure and occasionally bones is practised."

* Dr. Gardner travelled in South America before he took charge of Peradeniya Gardens. —Ed.

COCONUT STEM DISEASE.

April 3rd.

DEAR SIR,—In response to your inquiry, I may say that I have not lost a single tree from the disease. But Franklands being younger than Horrekelly, the wood is reached earlier, and cutting out is more urgent. The higher up the stem the disease is detected, the greater the danger. In one tree, with a six-foot stem, it was discovered I am afraid too late. The cutting up had to be carried up right to the fronds, that is up to the very heart. It remains to be seen whether that tree can be saved. My Superintendent will report in my absence. There is danger in neglected gardens.

F.B.

PLANTING IN NEW GUINEA.

RUBBER AND COCONUTS.

A recent number of *The Clarion*—a Melbourne Illustrated Journal—edited by "Ralph Bedford"—contains an interesting account of Papua, from which we take a few salient extracts ; but we miss any reference to the all-important question of Labour Supply. Even in the Government Regulations with all about Land Laws and general information, not a word is said on labour. Our first extract refers to a Coast village where, at least the Government insists on sanitary regulations. We read :—

In Samarai there is always a floating population from the goldfields ; the permanent white population numbers ninety. The great bulk of the black population of the island is in gaol. In the Eastern division of the Possession, of which Samarai is the capital, there are 74 coloured men other than Papuans, and a mixed lot they are. Of these there are seven Japanese, two Chinese, seven Malays, one Javanese, eight Filipinos, fourteen Solomon Islanders, nine Samoans, two Savage Islanders, three Raratongans, twelve Fijians, three Rotumah men, one Tahitian, on West Indian, three Cape de Verde

Islanders and one Indian. Of these, 34 are coloured teachers attached to the missions; the remaining 40 represent the alien labour of the division.

I landed and found the tropics truly, and their flowers and scents, and the smell of Colombo minus the important constituent of dirt. This insistent cleanliness is not present elsewhere in the tropics that I know of; here was a prison gang of broad-arrow clouted Papuans polishing the street with small brooms, and carefully placing finger pinches of dust in baskets One weary prisoner captured a piece of wind-blown paper, and was too tired to stoop for it. At last he picked it up with his toes and so carried it to the dust basket.

We are told the papaw grows like a weed, the breadfruit, "the great lily," the hibiscus, and wherever it gets root, the coconut grows. Here is our next extract:—

Mr. Staniforth Smith, as Commissioner for Lands and Surveys (with control of live stock and timber), Director of Mines, Director of Agriculture, Director of Public Works (including marine beacons, buoys, lights and shipping), and Chairman of the Land Board, has well begun to justify the hopes Australians have of the Papuan Constitution. He has established a coastal service at the Kemp Welsh River and at Rigo, and about to establish an experimental cocoa and coffee plantation in the hills. Tobacco, cotton, vanilla, and fibres require dry months, and Rigo is in the dry belt, as the Kemp Welsh is in the rainy belt. These three gardens will grow all the economic plants of the tropics except cinchona, which requires an elevation of 4,000 feet. The Government plantations will be both for demonstration and as supply grounds of plants and seeds to settlers, to be sold at actual cost, with freight added. Application for 126,000 acres for planting have been received, and of these about 90,000 acres have been granted. One million Para rubber seeds have been ordered from the Government of the Malay States at a prime cost of £400. These seeds will plant only 10,000 acres, and therefore much larger orders will be necessary, as of the million seeds not more than 600,000 are likely to prove fertile. The Para (or Hevea Braziliensis) is deciduous and on private plantations the seeds are mostly picked up with the leaves once a month; on the Malay States Government plantations the seeds are collected daily, and are therefore more fertile. The Australian ideas of progress recently imported into the administration of Papua are being the more energetically developed because the Cingalee and Malayan and Anglo-Indian prophecies of the White Australia spirit spelling ruin in the tropics have put the new Administration on its mettle. A move has been made to the making known of the virtues of many New Guinea woods—the Ilimo, a wonderfully light and very durable tree used by the natives for dugout canoes; the garo garo—a timber like boxwood; teak and ebony; several kinds of cedars; and the ulabo or cassi cassi, a hardwood approximating to the jarrah of Westralia. Also two Government plantations are to be founded for Government profit.

And then we have fuller particulars of planting —especially Rubber:—

AT SOGERI.

The time was 4 o'clock in the afternoon, and as usual—in this very wet season anyhow—the hot sun became overcast, the steam was beaten down by torrential rain. The jungle broke into a grass patch, closed again, opened to bamboo clumps, belts of cabbage palms, and at last led us into the plantation of Soge—the coffee shrubs white with blossom, the Para rubber trees raising their graceful foliage to the cloudy sky, the mountains so misty as to be but suggestions of height. We slipped on the last slide of the wet, red earth, and the compound of Sogeri was reached. The rain drummed on the palm-thatched roof of the home-stead, but ceased at dusk, and left us to a clear moonlit night—not cold, but cool enough to call for blankets. And this is not only to say that this soil, rainfall, temperature and altitude make ideal conditions for rubber-growing, but that the coolness of the nights makes certain the successful and healthful establishment of settlement by the white man.

After the night of coolness the wet slopes and valleys of the Astrolabe steamed under the morning sun, but by 9 o'clock the mists had risen and left clear day and clean heat. Immediately outside the compound was a living hedge of lime trees (called by the Papuan "Sipora") and a belt of Koru palm; and beyond, the green and white which were coffee shrubs, and the patches of red which are the chocolate soil of the Sogeri foothills. Eastward the Eworogo Valley goes to the main range with only a cloud or two lying lightly on it, appearing not distant in the clear air, although the peaks are 7,000 feet high, and the range is a week away.

Around us are the slopes of the coffee plantation, backed by the untouched bush. Coffee shrub and Para rubber and banana grove and belt of areca palm held in the fingers of the jungle's outstretched hand. Browns and greens of rubber trees and palm, and a few flat topped placid cedars, as at Garrick's Villa of Hampton, on the Thames. The coffee blooms three times a year, and is flowering now in dots of white; and then come the red berries among dark green leaves—a sight of beauty. Three kinds of rubber are here planted—the Ficus elastica, the indigenous Ficus rigo, and the best of all cultivated Para. Coffee will always be a good catch crop on the Astrolabe. The mild coffee of Sogeri must always be in good demand, as Brazilian coffees, which represent most of the world's supply today, are stronger and more bitter. The Sogeri idea is to plant Para rubber 10 feet or 12 feet apart, giving the trees sufficient growing room for the first six years, keeping down weeds and so lessening the maintenance cost, and bleeding alternate trees to death at a profit as they come to productiveness. Coffee plants like shade, and so could be grown between the rubber trees, further obstructing the growth of weeds, and maturing in three years. The condition precedent to the making of a plantation is the establishment of native gardens of maize, sweet potatoes, bananas, and taro, to feed native

labour, and so save the very heavy cost of imported rice. The gardens already established on Sogeri produce sweet potatoes up to 7 lb. weight each, and maize cobs over a foot long.

I visited the Queensland Government Experimental Farm at Kamerunga, near Cairns, where a number of Para trees and Ficus elastica were planted eight years ago. They are now tappable, and yielding from 1 lb. to 2 lb. of rubber per tree per annum, yet they are of very little larger girth than Para and Ficus elastica trees of half their age at Sogeri. Rubber in the countries of its origin grows in latitudes to 20 deg. south, in temperatures from 50 deg. Fahr. to 100 deg. Fahr., and in rainfall from 30 in. to 150 in. per annum. The greater the rainfall, the higher the temperature, and the richer the soil, the better the rubber, and the quicker its arrival at productiveness. There are cultivated Para trees at Sogeri three-and-a-half years old, 18 in. in circumference 3 ft. above the ground, and seeding in their fourth year, which means that they are mature and tappable. These three-and-a-half and four-year-old trees have been raised from seed; by raising from rubber stumps two years old, but cut back to represent a year of growth, it is possible to steal a year out of time by bringing the tree to certain maturity in the fourth year. The ficus elastica at Sogeri shows also a wonderful development in their four years of growth. The fact of the Sogeri trees being capable of production at four years is the most conclusive proof of the land being ideal for rubber growing; and from a comparison of the British Papua Land Company's country with the State Rubber Nursery at Kamerunga it is patent that the conditions of climate, soil, and rainfall represent perfect conditions for the rubber industry.

The vine rubber, a parasite, and not of high quality, grows throughout the jungle, mounting the tallest trees, and the settler of small resources might beat out his capital by cutting jungle undergrowth only, leaving the big trees, and planting the vine parasite around the standing trunks. Practically no clearing is required beyond scrub knife work, the vines can be tapped in the fourth year, and conveniently near the ground and the big trees would clear themselves in time by dying; for as soon as the sunlight is let into the jungle the jungle begins to die.

The Para tree itself is a beautiful thing, and when are added the spotted white and glossy green of the coffee plants on the red soil slopes, the long hedges of flowering limes, the living fence of rooted sticks, the thatched roofs of the native houses, the great prone cedars rotting red in the recurrent rains and sunglare, coconut and banana palms threshing their fronds in the spiced air, and a grove of a thousand betelnut palms moving their feathery tops lazily, Sogeri's beauty becomes indescribable only with superlatives.

The hot days and the rainfall spell financial success; but the cool nights and the bracing air of the plateau mean successful settlement by white men. A settler may take his wife and children to his new country, and be satisfied that the climate will prevent the deterioration of family life so common in India and other essentially tropical countries; the living conditions of the Astrolabe will provide for the white rubber planter congenial and profitable occupation in a perfect climate, which perfection of climate means that he will become a permanent settler, because the social side of life will not be lost to him. March is the finest month of pictures in the jungle of the plateau, when the D'Albertis creeper is in bloom, all flower and no leaf, blossoms like red beacons flaming from soil so treehead; but for every month there is a special beauty.

Having secured his land and his capital, the next work of the planter is the finding of labour—easy enough locally, and within limits if he be known and liked; easy enough at a distance if he be a stranger. But distant recruiting calls for a fair initial capital if the plantation be on modest lines; and for the ownership of a schooner and a correspondingly larger captial if work on a big scale is intended. The land laws of the Paupan Government are liberality crystallised; for settlement is warmly welcomed by the new regime, the only demand being that the settler shall till his land, and not shepherd it as speculation. The first work of the new planter is the establishment of gardens for foodstuffs for his native labour and the second the clearing and planting of the time and money in a big plantation's ownership of schooner, the craft in slack times could earn profit as a goods carrier, and also as a recruiting vessel for other people.

Having regard for the harbours to be entered, I recommend a 45-ton schooner, able to carry 20 tons of cargo in addition to providing a space for natives in the holds. A draught of 7 ft. 6 in. (in ballast) would suit the anchorages and rivers to be entered in recruiting. Bunks are not necessary, and the open hold is more healthful. As ninety or more natives would be recruited at a time, adequate fresh water storage should be provided for. The schooner should be a fast sailer.

The only drawback to investment in rubber cultivation is the long five years of waiting and dead work until the trees are of tappable size; but once producing, the returns are very great, and continue for more than the average lifetime of a man. The investor who enters a rubber-planting enterprise at the outset enters the business in the cheapest possible way; he is paying no profits to people earlier in the business, and he is assured of huge returns after the necessary period of growth to the point of productiveness. That once reached his capital must return to him twenty-fold, promising always, of course, that the plantation is working mainly for capital invested, and not mainly for hot air and water. Of all the countries of the earth where planting of Para rubber is proceeding, no country has such excellent prospects as has the Commonwealth's possession of Papua. The Government asks the planter for no money for the Treasury, demanding of him only that he shall put capital into the ground, and thus a plantation requires no purchase capital, but only a working capital. And of all Papua the Astrolabe has ideal conditions for the culture of Para.

I will not soon forget my last night at sogeri—moonlit, cool and very clear—the peaked thatch of the plantation houses casting queer shadows; the Koru palms very stately under the moon; the heights behind treed to the lucent blue scent falling through the moonrays from the bloom of sipora, Seville orange and mandarin to the moist earth, and the coffee shrubs climbing up the foothills.

There is a final comparison in respect of coconuts and copra which must be received *cum grano.* The "25 average" for Ceylon, of course, refers to the whole island—neglected old native gardens as well as plantations. There are many plantations in Ceylon giving 40 to 60 nuts per tree and special palms can be shown bearing up to 100 to 125 equally with the few palms as yet tested in New Guinea :—

I have never seen such prolific bearers as these coconut palms of the Maiwara. The sight of them made plain the superiority of Papua as a copra country over most of the established copra-producing countries. In Ceylon the average annual yield per palm is twenty-five nuts ; but of the Ceylon nuts 5,000 will make a ton of copra. In the Solomons the average annual yield is eighty to ninety-five nuts ; but it takes 7,000 nuts to make a ton of copra ; but the Papuan coconut palm bears from 100 to 125 nuts per annum, and 5,600 nuts will make a ton of copra.

From the Government Regulations, we quote :—

RUBBER.

So far as our information goes, there is no country better suited for rubber growing than Papua. It possesses an immense area of easily accessible virgin forest and scrub land lying along a great portion of its 3,000 miles of coast line, and great tracts of equally good land in the interior.

Healthy well-grown Para trees should each average after the fifth year, 2 lb of rubber annually, which at the present price (5s per pound), would yield a gross income from 500 acres of £21,500, or over 250 per cent. per annum on the outlay, assuming that no catch crops were grown. Even if rubber dropped to 2s per lb, the gross income would be over 100 per cent per annum.

COCONUTS.

This is a very remunerative and most reliable industry, and one that should receive quite as much attention as rubber cultivation. The natural conditions are in every way suitable, and skilled labour or extensive plant is not required in the production of copra. Papua, being outside the hurricane belt, possesses a great advantage in this respect over such places as Fiji, the New Hebrides, and Samoa.

The trees begin to yield in five years, and are in full bearing when eight or nine years old. A full-grown tree should yield 60 nuts a year, and with 50 planted to the acre, that area should yield 3,000 nuts, or half a ton of copra, worth £10.

INDIGENOUS PRODUCTS.

The Territory of Papua possesses a wealth of indigenous plants of commercial value that it would be difficult to equal in any other country. These include large forests of sago, sugar-cane of the first quality, rubber, both tree (Ficus Rigo) and vine—the present market value of which is between 4s and 5s a pound—also coconuts, nutmegs, tobacco, ginger, bamboos, areca palms, fibres, bananas, breadfruit, and vegetables of various kinds.

Land is to be got on easier terms than, we suppose, in any other British dependency ; but as we said, not one word is said about "Labour," and without it, what can any colonist do ? It is absolutely ridiculous to suppose that even the maritime part of New Guinea is suited for white settlers to work either own lands.

TROPICAL AGRICULTURE AND ARTIFICIAL MANURES.

December 12th.

DEAR SIR,—In your leading article on the above subject, in your issue of the 2nd inst. [see next page] you draw the attention of the veteran "Cosmopolite" to a few casual remarks of mine in a recent issue of your paper as to the value of "artificial" manures.

As the subject is of paramount importance in an agricultural country, I wish to express an authoritative opinion on the subject. I write with some degree of authority as, I believe, very few individual planters, certainly not coconut planters, spend more on manure and use larger quantities than I do. The annual average of the manure I apply is about 100 tons of "artificials" and 25,000 cubic feet of cattle manure. My opinions are, therefore, backed by a somewhat extensive and prolonged personal experience.

So much by way of introduction. I am entirely in agreement with "Cosmopolite" as to the great value of bulky manures, such as cattle and green manures, chiefly the leguminous nitrogen-gatherers. I am a firm believer also in the great value of tillage ; but I have no prejudice whatever against "artificial" manures. I place great value on them as necessary and valuable adjuncts to bulky manures. I do not favour the highly concentrated, and, therefore, the injuriously stimulating "artificials."

In the Coffee era, many upcountry estates had extensive cattle establishments and piggeries. There was a great prejudice against these manures chiefly owing to their high cost. First of all the maintenance of these establishments costs much in grass gardens, poonac, keepers, &c. Then came the matter of transport, especially where large, central establishments existed. It became necessary to open and maintain cart roads. The transport on coolies' heads, too, was very expensive. With the decadence of coffee, cattle establishments died out.

A new era followed, with a highly-trained and practical Scientific staff attached to the Royal Botanic Gardens. By a course of popular lectures and practical illustrations on the experimental gardens, the value of leguminous plants as a manurial agent and a source of humus was abundantly illustrated. Now an inexpensive source, comparatively speaking, of course, of bulky manure is available to every

estate, whatever its altitude, and however far removed from a cart road. But there was an interregnum betweon the era of expensive cattle establishments and the easily available legumes. During that period the Tea industry came into existence and is, what it is *entirely* with the aid of artificial manures.

To come to my particular subject: Coconut Cultivation. I am in charge of an estate of over 50 years of age and with a large percentage of the soil, a poor, white sand. By regular tillage of the soil and the application of manure every alternate year, the crops have been increased by 25 per cent, and the condition of the trees will compare favourably with younger trees in localities more favoured as regards soil. The "artificial" manures I use are castor cake, fish steamod bones and potash, all natural products. As stated at the beginning of this letter, I apply very large quantities of cattle manure also, but almost exclusively to tho white sand portions of the estate. I endeavour to increase the supply of humus-yielding material by growing and burying crotalaria and the nitrogen-gathering legumes. But these cannot be grown as largely here as they are grown on up-country estates, as the passage of carts through the estate crushos down the crotalarias.

I have found an application of lime and kainit to such fields as did not respond satisfactorily to the application of other manures, yields very encouraging results. I did not lime the entire surface of the soil and with heavy doses as in European agriculture. I applied a small quantity to each tree chiefly with the object of galvanising into activity the latent nitrifying organisms in the soil. To sum up, my opinion, based on extensive personal experience and observation is that "cultivating" the soil is an absolutely necessary operation of successful agriculture. That wherever obtainable, cattle manure and other humus-yielding applications, with "artificial" manures, yield the most satisfactory results. That the supply of cattle manure being limited, the use of "artificial" manures becomes indispensable and yields remunerative results.—Truly yours,

B.

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(By Cosmopolite.)

That was a most excellent letter from "B" of Marawila on the above subject, which appeared in the *Observer*, and I am ready to admit that he has had much practical experience, even although we may not agree in all things. When I read—"the annual average of the manure I apply is about 100 tons of artificials," I said to myself—"poor chap, what a waste of money"; but when I found that he added "and 25,000 cubic feet of cattle manure," I joyfully exclaimed —"Good you are 'B,' you are going strong and deserve all the success I am sure you are having." He goes on to say, "I do not favour the highly concentrated and, therefore, the very injuriously stimulating artificials." Now, Mr. Editor, these are almost my own words, which appeared in your own paper several years ago, when I said that it was impossible, on some estates, to get all the cattle manure necessary, and the residue had to be made up by such manures as bones, poonac, castor or rape cake, which could scarcely be called artificial, as thoy are, in reality, natural products. But, although I have no prejudice against these, I still prefer cattle manure, if it is to be got at all, and would grudge paying for the above "artificials" if I could do without them. "B"'s letter is the best on the subject of manuring that has appeared in your columns for many-a-day, and I am taking the liberty of filing it away in the book in which I keep copies of any articles that I consider worthy of being read a second time, and even more times. "B" writes only of his own experience, and the effect of various manures on his own estate. I also have only given my experience in connection with my own ground, and I have no wish to dissuade any one from purchasing "artificials" if he finds them suitable to his land, but let the advocates of "artificials" always remember the old saying about planting in Ceylon, that "many million British sovereigns have been buried, in tho shape of manures, in the coffee clad hills of Ceylon that will never be resurrected again."

GROUND-NUT.

Ground-nut seems destined in the near future to cover a great deal more ground than in the past, says the *Bombay Gazette*. This is true, at any rate, of the Southern Presidency, where, having hitherto been raised on a systematised scale in a very circumscribed area on tho Coromandol Coast, it has now been introduced with the most encouraging results on the Malabar Coast, where it has been up to now as a dryland crop, and has proved far more profitablo than the dryland crops that are usually grown. On a coast with a heavy monsoon, the crop will probably take from six to six and a half months to mature. Harvesting should commence when most of the nuts are ripe. Ripeness is denoted by the skin of the kernel assuming a pink colour. After the nuts have been gathered they should be sun-dried for several days, being heaped up every evening and protected with straw and spread out again the following morning. Owing to the heavy rainfall, ground-nut cultivation should not be continuous from year to year, and Mr. Sampson, Deputy Director of Agriculture, Madras Presidency, suggests the following rotatory system: —One year ground-nut, next year cereal, third year fallow. Throughout the period of cultivation, the growing crop should be watched, and after the pods are formed, the watchfulness should be redoubled, as jackals, jungle rats, crows and other enemies will persistently attack the pods, and do much damage if they are not scared off.—*Indian Agriculturist*, Feb. 1.

STATE AID FOR AGRICULTURISTS.

The Work of the Bengal Seed Depot.

"A circular is issued by the Bengal Department of Agriculture referring to the operations of the Bengal Seed Store in Pollock Street.

To meet the long-felt want of good seed the Bengal Seed Store was opened to work in connection with the different Provincial Farms where definite varieties of seed are grown,

After deducting the farm's own requirements for the following season, the seed is sent to Calcutta, where it is cleaned, tested and stored in rat-proof bins specially designed for keeping the seed clear and dry.

The storing was the first step. In all transactions it was decided that local rates would be charged, the Government bearing all the expenses incurred by rent of depot and the charge for running the establishment. The buyer, therefore, gets all the benefit of tested seed of a known variety at usual rates.

In all 1,073¾ maunds or 88,354 lb. of seeds were distributed during 1907—without including sugarcane cuttings. On an average a quarter of a maund of seed will give sufficient seedlings to transplant one acre of rice and ¾ maund is sufficient for broadcast cultivation, and we supplied 144 maunds of seed, *i.e.*, sufficient for 314 acres. The area for 1907 in Bengal under rice (aman and aus) was 24,291,000 acres. Therefore the field is vast enough for many private undertakings. Next, 266 maunds of jute seed was distributed and the area under jute in 1907 for Bengal alone was 931,100 acres. Now 4½ seers of seed are required per acre, therefore we were responsible for 2,364½ acres.

We must state here, however, that we have not yet reached the humb'e raiyat himself, as most of the demands came from big zemindars, either Indian or European. It will take more time to induce the raiyat to leave off his custom of buying from mahajan at cruelly high rates or of using the seed of the poorest plants of his field, and still more time to prove to him that there is such a thing as improvement. It is only by gradually instructing him, by object-lessons, in our future demonstration farms, that he will venture in unknown paths. General education will have come to the rescue; not the academical one which has been so fertile in inundating Bengal with clerks, but the practical teaching of natural fact undertaken in a genial manner. Why should there not be itinerant teachers who would, like in Norway and Finland, go from village to village assembling children and grown-up people when work in the fields is slack to do this pioneer work—teachers taken from among the raiyats themselves and taught.

The cost of running the seed store for 1907 was:—Rent Rs. 2,400; establishment Rs. 1,362, or a total of Rs. 3,762. If pessimists see in this outlay of money made by Government for agricultural improvement a waste of public money let them ponder over what other smaller nations have done in this direction at far greater sacrifices and let them hear the results. Sweden, with a population of 5½ millions, gives for seed improvement and distribution to the institute of Svalof alone a yearly subsidy of Rs. 24,090. The members of the Institute or members of the Agricultural Associations give yearly subscription fees amounting to Rs. 3,375. Three years ago, when it was decided to erect new buildings for the institute with the latest up-to-date fittings, the sum of Rs. 569,455 was spent for that purpose.

Besides seeds we store at the godown a few manures for the use of cultivators who may obtain small quantities at the lowest market rates. We must state here, however, that artificial manures are not yet appreciated by the raiyats, and except by experimental stations and a few planters very little seems to be used in Bengal. —*Bengal Agriculturist*, February 1.

CAMPHOR.

I was pleased to read, in the "*Ceylon Directory*" that the growth of camphor is being encouraged in your island, because there can be no doubt, but much of it will be required for smokeless powder, before all the wars which present day prophets are predicting are satisfactorily finished. But there is another use, that, I think, the camphor tree might be put to, namely, as a preventative against the attack of insects on other shrubs. It is well-known that the wood is pervaded with camphor and that insects will not attack it. How would it do, therefore, to plant camphor and tea, or camphor and coffee alternately and trust to the former protecting the latter from the numerous *poochies* that attack these to the sorrow of all planters. Cabbage plants, as a rule, suffer from insects, which simply ruin them, but if those are put in alternately with lettuce plants, they are left severely alone, as the laudanum in the lettuce is not to the taste of the cabbage fly.—COSMOPOLITE.

CAMPHOR CULTIVATION.

April 8th.

SIR,—I have noticed a few branches dying back on some of my old camphor trees and have seen some 5-year-old bushes that have snuffed out unaccountably. There may be some local cause in the soil or through adjacent poisonous roots; but later on, the Peradeniya Staff should look into the matter and make an investigation.—Yours truly,

PLANTER.

PLANTATION VESRUS WILD PARA.

M. G. Lamy-Torrilhon, of the great French india rubber manufacturing firm, gives in the "Journal d'Agriculture Tropicale" his opinions regarding the vexed question of cultivated v. wild Para rubber.

His conclusions do not differ markedly from those which have been reached by every impartial observer. After pointing to the preference given by manufacturers, apart from the question of loss on washing, to the wild Para rubber, he attributes the deficiencies of the plantation product (1) to the non-observance of the South American system of curing, and (2) to the comparatively young age of the Eastern trees.

When these two defects are remedied—the first by the introduction of Brazilian methods (in so far as they are good) and the second by the natural efflux of time, he thinks that cultivated rubber will have a very strong position.

M. Lamy-Torrilhon does not seem to be struck with the wet block process, but advocates the simultaneous smoking and coagulation of the latex.—*India Rubber Journal*, March 23.

NOTES ON SOME FAMILIAR LOCAL PRODUCTS, &C.

KAPOK.

Samples of Philippine kapok have been sent to these parties and the reports on these samples have, in general, been very favourable. The latest report received states that well-cleaned Philippine kapok would be marketable in New York City at 14½ cents, United States currency, per pound. The firm making this report states that it would be prepared to make a contract for all the kapok that the Philippine Islands could produce. Another firm in the United States with which we have been in correspondence has recently placed a preliminary order for a ton of Philippine kapok. The export trade in kapok is now handled by two reliable business firms in Manila to whom are referred such inquiries as we receive on this subject.

SEED PRESERVATION.

Some original laboratory work has been carried on during the year in the preservation of seeds. The results already achieved promise to solve a problem which for many years has been vexing importers and handlers of seed in all hot countries where the minimum atmospheric humidity never falls below 55° and the mean normal for one-half the year approximates 85°. Hermetical sealing, while a protection to the seeds in transit, is of no assistance after arrival unless the seeds can be disposed of as soon as opened, which is of course impracticable for merchants and others handling seeds in large lots. The difficulty of preserving the vitality of seeds in this country is indicated by the fact that peas, which on arrival from the United States gave us an 84 per cent. germination test, failed entirely thirty days later. Corn, cotton, and other oily seeds have deteriorated within three weeks.

The experiments described below were conducted with a lot of very fine American corn seed received here early last December, and which showed the remarkably good germination average of 95 per cent. The object of these experiments was to determine the value of the method of keeping seed in hermetically sealed jars as compared with the method used in this Bureau. Three 2½-pound lots of the corn were taken at random from the shipment. One lot was placed in an ordinary metal seed canister with a reasonably close-fitting cover. A second lot was placed in a glass jar provided with a close-fitting ground-glass stopper and at once hermetically sealed with melted paraffin. The third sample was put in a similar jar in which had been placed an inch of coarsely broken charcoal that had just been exposed to a heat high enough to expel the moisture. While the charcoal was still warm, the corn was poured in and the whole topped off with another inch of charcoal. While still open it was exposed for thirty minutes to a gentle heat (43°-C.) and then carefully sealed. This was on December 23rd, 1906. On May 23rd of the present year (six months later) the two jars were opened and 100 seeds taken from each, a like number were taken from the closed canister, and all were placed in the germinators. These tests were concluded on June 1st and we obtained from the heated jar containing the charcoal a 91 per cent. germination, from that only hermetically sealed a 28 per cent., and from the canister a 36 per cent. germination. The tests were sufficient to demonstrate that hermetical sealing unless precautions are taken to expel the very moist atmosphere is detrimental rather than beneficial to the seeds. The unusually good showing (36 per cent.) of the unprotected seeds was due in part to excellence of vitality at the start, and still more to the abnormally low reading of the hydroscope and the high, dry winds which marked the first quarter of the present year. Since the beginning of the wet season, however, the exposed corn has deteriorated more rapidly than that which was merely sealed. At the conclusion of the tests the heated corn was treated anew in the same manner and will be kept for future tests of this method. The average life of most garden and field seeds in temperate climates, without other provision than a cool, clean, dry bin, is four years, the extremes being two to ten years. These tests demonstrate the possibility of preserving all seeds even under the trying conditions which prevail in these Islands. It is obvious that the importation of seeds of good quality is an indispensable factor to successful preservation and that the cost of the method of seed preservation herein described would be great for large quantities of seeds, as they would have to be placed in small jars and much charcoal would be required. Large containers might be used, but, as it would be difficult to fully exhaust the damp air and to promptly seal such containers, the danger of loss would be increased. The tests which we have made indicate that seeds from temperate countries can be preserved in the Tropics by the method described, although the use of this method on a commercial scale may not always be practicable.

SESAMUM OR LINGA.

Further work was done with this oil-seed crop to determine the season when its planting would be attended with least risk from loss. In rich soils it make so rank a growth that it is apt to lodge during heavy rains when approaching maturity. On the other hand, a liberal supply of water is necessary for the production of a good crop. The first trial made at the opening of the dry season resulted in a dwarfed growth and a very inferior crop. From a planting made in June, 1906, we harvested a grain product at the rate of 473 kilos per hectare. Some grain was lost by lodgment from the heavy rains of September, but the amount was small and certainly less than one-fifth of the total. From this it seems better to take the risk of loss from rain rather than to invite the more complete failure resulting from drought. The Philippine Products Company has declared sesamum to be the most tractable oil seed which comes to their hands, and it is our aim by further experiments and distribution of seed to promote this industry as a promising source of revenue to the small native farmer.

CAROLINA GOLDEN RICE.

As the result of favourable preliminary work, further experiment and a wider scope of introduction were carried on with this grain. A

plat of it sown in drills 18 inches apart, on July 13, was cultivated very much as corn, had no artificial irrigation, headed up in ninety days, was harvested in one hundred and twenty days, and yielded on thin, sandy land at the rate of 52 cavans to the hectare. In the rice experiments, one of the aims of the Bureau has been to reduce to something like uniformity the great number of varieties of rice grown in these Islands. In Carolina golden we have found a variety which is of good size and form, very early, prolific, of excellent milling properties, and uniform in ripening. It is a lowland rice, but cannot be transplanted to advantage. The native farmer being accustomed to transplanting all lowland rice, the distribution of Carolina golden must be made with caution and preceded by educational work pointing out the radical changes in method of planting required. As rice is the most important of our cereal crops, and as Carolina golden appears so nearly to meet the standard of requirements, it is desirable that we make long-continued experiments both with this and other varieties.

VANILLA.

Some vanilla plants brought here a few years ago were lost in the typhoon of September, 1905, and in view of the depressed condition of the vanilla industry no efforts were made to reintroduce the plant. A few were received as exchanges about a year ago and were planted out at the Singalong exmeriment station. They have grown exceptionally well. Some of the plants have made leaders 3 meters long and are quite robust. This rate of growth is unusual, even in Vera Cruz, where the plant is supposed to attain the highest degree of perfection. It probably indicates that the conditions about Manila are very favourable for vanilla growing and that the distribution of these plants is to be recommended.

PINEAPPLES.

A few of the Natal pineapples brought here from Durban have fruited. In tenderness and in freedom from fibre and core they are a marked improvement over the Bulacan variety which has been grown at Lamao. We have lately secured 200 plants of the variety grown in Marinduque and have planted them out along with the West Indian varieties now growing at Singalong. This makes five kinds we now have growing at this station, viz., Smooth Cayenne, Ripley, Red Spanish, Natal Canning, and Marinduque. The trials proposed include fertilizer and irrigation tests, determination of the relative yields and quality of fruit of the different varieties and the production of plants for distribution.

COFFEE.

The small planting of maragogype hybrid coffee made in Lipa, Batangas Province, four years ago produced last year a first crop of a little more than 1 pound of berries to the tree. Although not immuno to the leaf blight, it is so strongly resistant to the disease and has survived so well in that pest-afflicted region that the berries were all quickly bespoken by old coffee planters of the district, quito a number of whom have planted seed beds for the purpose of renewing their plantations. As this seed was quite unfit for planting, it is difficult to avoid the conclusion that some future disappointment is in store for these planters whose enthusiasm has outstripped their knowledge or wisdom. The few trees at the Singalong Experiment Station are of the same age, and are equally as good as the plants at Lipa, notwithstanding the unfavourable environment.

CASSAVA.

Small plantings of the native white cassava were made with a view to testing its growing period, yield, and composition. This variety seems to reach maturity in about ten months. No satisfactory yield tests could be made on account of the constant depredations of hogs running at large in the city at night. A number of samples analyzed contained about 28 per cent of starch, which is 2 per cent more than is credited to this root in Florida, whore it is grown extensively for the manufacture of starch. Cassava is now receiving some attention from prospective manufacturers of starch and tapioca in this country.

ASH-PUMPKIN.

This was grown as a trellis plant, and from a single vine 62 fruits were obtained. Chinese buyers are always on the alert to procure this fruit. The average yield of a single plant of Benincasa is about six fruits, and the extraordinary yield cited above was due to the exercise of a slightly modified system of pruning practiced, though rarely, by Filipino gardeners. It consists merely in splitting the main stem and leading branchos and inserting wedges, which procedure has the effect of checking leaf growth and developing flowers. In addition to this, "pinching back" was practised with the result mentioned above.

SEED GERMINATION.

Experiments conducted in Manila show that perfectly fresh seeds of many plants are affected by extremes of either drought or moisture. At altitudes of 4,000 to 5,000 feet these conditions, if accompanied by low soil temperatures, are still more unfavourable for germination. Tamato and eggplant seeds planted at Baguio in January, 1904, failed to germinate and were pronounced defective. Early in May of the same year, when the seeds were four months older and presumably not improved by age, they germinated freely.—*Philippine Agricultural Review*, for Jan., 1908.

PASPALUM DILATATUM AND COCONUTS.

Fiji, 24th Feb.

DEAR SIR,—Can any of your readers kindly say whether *Paspalum Dilatatum* has proved injurious to coconut palms in Ceylon?—Yours, etc.,
H. H. T.

Office of the Ceylon Agricultural Society,
Colombo, April 3rd.

SIR,—With reference to your letter of the 1st instant on the above subject, I have the honour to inform you that I have never heard of any such injury, and I do not know of any coconut estate in Ceylon where this grass is grown. Paspalum Dilatatum does not do well in the low country.—I am, Sir, your obedient servant,

C. DRIEBERG, Secretary.

VISIT OF A WELL-KNOWN LONDON RUBBER AUTHORITY.

MR. F. DE BOIS MACLAREN INTERVIEWED.

Rubber in Malaya, Java, Sumatra and Ceylon.

A prominent figure in the London Rubber World is Mr F de Bois Maclaren, of the well-known Shoe Lane firm of Publishers, Messrs. Wm. MacLaren and Sons, who among other publications own the "India Rubber Journal." Mr Bois Maclaren, who is Chairman of the Rubber Estates Agency, Ltd., and a Director of the Kepitigalla Rubber Estates, Ltd., and the Shelford Rubber Estates, Ltd , has been on a visit to the Malay States, Java and Sumatra, in all of which countries his firm has extensive interests and he is now spending some time in Ceylon on his homeward journey. Mr Maclaren has for many years been in close touch with the India rubber market and in conversation with an *Observer* representative today be expressed the belief that the market was improving and the outlook becoming brighter. "Several manufacturers told me," said Mr Maclaren, "that they were using mixtures with their rubber when the price was high, but now that the price has fallen they can use pure rubber and give a better quality article and I believe that is what they will do."

The Best form in which to send Rubber to London.

"What do you consider the best form in which to send plantation rubber to the London market?"

"The biscuit is in most favour at the present time, rather than crepe or block. Manufacturers have, however, been very unsettled indeed in their preference, Sometimes crepe was the favourite form, at other times the biscuit and at one time block found the readiest sale. Biscuit, the present favourite, is easily made and there is no form of rubber almost in which you can detect impurities so readily as in sheet and biscuit which you can hold up to the light."

Competition with Brazil.

"What do you think of Eastern plantation rubber's chances in competition with Brazil?"

"I think you in the East will be able to compete very advantageously. Brazil has been feeling this fall in price very much and the money put up for equipping expeditions for the collection of rubber, as they have to do in Brazil is not forthcoming this year. It has collapsed to a large extent so that will mean that there will be a smaller quantity of rubber coming in from Brazil next year. If that is the case and the American demand comes back to anything like its former extent one can naturally expect a considerable rise in the price of plantation rubber, provided, of course, that nothing unforeseen occurs,

"What do you consider the 'killing out price' for Brazil?"

"Well, there has been a good deal of discussion upon that point. At one time Brazil was able to send rubber into the market, and I suppose make a profit at a considerably lower price than at present; but, now, I would say labour is dearer than at that time and the expenses of firms are much higher than those of native firms which did business in a modest way, and altogether I should not think they would be able to put rubber into the market, unless the export duty is taken off, at less than 2s 6d per lb. Exchange currency has been a very speculative thing out there for many years and when men were not making profit out of rubber they made it by speculating on currency exchange; but that of course is not sound business."

Ceylon V. Malaya, Java and Sumatra.

"How do you think the growth of our rubber in Ceylon compares with what you saw in Java, Sumatra and the Malay States?"

"Very well upon the whole; but the growth in Ceylon is undoubtedly slower. This is more observable in trees that are of mature age. A tree for instance that is 12 years in Ceylon would not average better than a tree of 9 years in the Malay States, Java or Sumatra in a good situation. I would say the growth in these three countries are fairly equal: one place has not much advantage over the other. In the Klang district in the Malay States where a number of the Companies that have been doing so well are situated the tree cannot get a deep root because they get to bad soil at a depth of 5 feet and in that district you often see

A large proportion of trees blown down.

I think Sumatra and Java have equally good soil to the Malay States and are minus this dis-advantage."

Labour.

"Did you find labour plentiful in all the countries you visited?"

"Well, the Dutch are always talking about requiring labour for themselves and they hint that some day they will prohibit the export of Javanese labour to the Malay States; but then there is now a very fair supply of Tamil Labour available so I do not think there is likely to be any serious difficulty on account of labour. There may be temporary difficulties but nothing of lengthy duration.

"I was very much impressed with Java. It has the soil and the climate and everything one could desire—that is in West Java and Middle Java—(the East and North of the island are drier); and there is certainly no cheaper labour to be found anywhere in the world. There are 32 million people in that island which is one of the most densely populated parts of the world. Cheap labour will be available there.

"Yes: I think moderately capitalised and well managed properties in Ceylon will always be able to compare favourably with the rest. They may not perhaps give per acre such high returns but the returns will be satisfactory."

Over-tapping in Malaya.

"There is," said Mr Maclaren, "a great deal of over-tapping going on in the Malay States. Trees of 18 inches and so on are being tapped in a way they should not be; and that will have to be paid for later on. The trees must get a rest. I do not think it at all advisable to tap trees under 20 inches and then not above 2 feet from the ground where the bark is fairly thick. When you get up to 3 feet or over from the ground, the bark of a tree of that circumference is certainly too thin. I know of estates the bulk of the trees on which will certainly need to get a rest. People have been pressing for big returns this year to make a fair show but they will have to suffer for it later on."

The Passing of High Purchase Prices.

"There is one thing sure in connection with rubber," said Mr Maclaren, "and that is that the day of high purchase prices and big promotion profits is gone for ever. My experience of Ceylon planters trying to sell estates, and I have met a good few of them, is that they want a higher value for them than is given in any part of the world and they do not seem to realise that an estate is worth less per acre when rubber is at 2s 9d. per lb. than when it is at 5s. 6d. They do not seem to have awakened to the change that has occurred."

MR. J. L. SHAND'S VIEWS ON RUBBER GROWING.

Mr. J. Loudoun Shand after an extensive tour in the Federated Malay States, visiting estates notably in Malacca, Selangor and Negri Sembilan, accorded an interview to a *Ceylon Observer* representative, in the course of which the following appeared:—

"As to the growth of rubber," Mr Shand remarked, "I think it is rather quicker than in Ceylon. Its appearance is good, too. On the subject of expense, I think, Ceylon will produce the cheaper of the two."

The Weed Difficulty.

"The weed difficulty? I don't think this will prove a permanent impediment at all. It is certainly somewhat of an expense just now, but as the trees begin to form a good shade this will gradually disappear. Weeds do not grow very strongly in a good shade and there is every prospect of this developing. There is no indication at all of weeds proving a permanent drawback."

RUBBER PLANTS FROM CUTTINGS:

Interesting Experiments by a Burmah Planter.

Tavcy, Burmah, March 22nd.

DEAR SIR,—The following may prove interseting:—(i) After my planting in June I went over the remaining 10,000 or so plants (Para rubber) in the nurseries and pruned all the "double headers" there were, leaving one stem to each root stock. Most of these were cut off just below the ground level. A number of plants, too, with twisted roots were cut down below the twist, hoping they would send up a shoot from the root left, which, I may say, they have done. I obtained 509 cuttings, about 250 of which had small fibrous roots, but none had very much root development. These were all put down in a nursery near the bungalow and carefully looked after. This occurred in August last. Now in March I find I have 393 established plants all looking well. (ii) Also in August last a family of porcupines raided me, and in 3 nights bit off, and otherwise destroyed, 715 2-year old plants put out in the previous June. Supplying was done at once and one or two of my men brought to the bungalow a lot of the bitten off stems. These were left lying in a heap for 7 or 8 days when I bethought me, in a spare moment, of sticking them with the nursery, too, to see if they would succeed as cuttings. These, too, were well looked after and watered as required. Altogether 85 stems were put in having first had their gnawed and bitten ends cut off clean with a sharp knife. Now in March I find I have 56 of these alive and well and looking as if they had thoroughly rooted themselves. The shoots they have thrown up (pruned off to one each) are vigorous and in full growth.

How often one's best efforts result in failure and things more or less carelessly done and under adverse circumstances prove successful?

I am sorry that in the first experiment I did not count *exactly* how many of the cuttings had small fibrous roots and how many had none, but to the best of my recollection certainly not more than 50 per cent were, more or less, generally less, rooted.

J. G. F. MARSHALL.

ARTIFICIAL SILK IN JAPAN.

A factory is reported to have been established recently in Japan to produce five tons of celluloid and half a ton of artificial silk daily. Celluloid, as is well-known, is made by treating nitro-cellulose with camphor, and Japan, including Formosa, furnishes about four-fifths of the world's supply of camphor, which is, moreover, a Japanese State monopoly for export purposes, and is constantly rising in price. The best artificial silk is that produced by the Chardonnet process, which likewise makes use of nitro-cellulose as a raw material, and it is asserted that Japan, although a large silk-producing country, has hitherto imported a considerable quantity of the artificial silk, which is used in Kioto for making tapestries, screens, and embroideries. It will thus be possible for the new company to employ its raw material either for the preparation of celluloid or for artificial silk in accordance with the state of the market.—*Commercial Intelligence*, March 11.

MANURIAL EXPERIMENTS ON COCOA.

Interesting papers in relation to the West Indian cocoa industry were read at the late Agricultural Conference. The Hon. Francis Watts, C.M.G., summarized, on behalf of Mr Joseph Jones and himself, the results of manurial experiments with cocoa in Dominica, while Mr R D Anstead and Mr J C Moore reviewed the progress of the experimental work carried on at Grenada and St. Lucia respectively. Mr Joseph Jones also read a paper on trials in grafting cocoa which have been made at the Dominica Botanic Station. A summary of Dr. Watts' remarks dealing with the Dominica experiments is given below, followed by a reprint of the paper presented by Mr Anstead:—

COCOA EXPERIMENTS IN DOMINICA.

Manurial experiments are carried out in Dominica both at the Botanic Station and in the country districts. Those at the Botanic Station have been in progress since 1900, and now present results of considerable interest, clearly indicating the value of judicious manuring on the part of the cocoa planter. There are five cocoa experiment plots at the Station. Of these, one has been regularly manured each year with an application of 4 cwt. of basic phosphate and 1½ cwt. of sulphate of potash per acre, a second plot has been annually treated with 4 cwt. of dried blood per acre, and a third has received a complete manure (containing nitrogen potash, and phosphates), composed of 4 cwt. of basic phosphate, 1½ cwt. of sulphate of potash, and 4 cwt. of dried blood per acre. The fourth plot has been annually mulched with grass and leaves, while the fifth has received no manure whatever.

Considering the crop returns obtained during the past five years, the results show that the use of phosphates and potash on the first plot has increased the yield of dry cured cocoa by an average of 219 lb. per acre per annum over the yield given by the unmanured plot. The use of the dried blood alone, primarily a nitrogenous manure, increased the return of cocoa by 187 lb. while the combination of the two sets of manures, i.e., phosphates, potash and dried blood resulted in an average yield of 374 lb. per acre per annum over and above that obtained from the unmanured plot. The mulching gave the greatest gain of all, viz., 402 lb. in excess of the return from the unmanured plot. Dr. Watts mentioned also that the cocoa trees on the mulched plot are much finer and better developed than those on the other plots, and also that the soil of the mulched area is in exceptionally good physical condition. Although such good results have been obtained with mulching alone, Dr. Watts pointed out that in many cases it will be well to supplement mulching with moderate applications of nitrogen and phosphate. It is believed that potash is not urgently needed as a fertilizing constituent in Dominica, as the soils of the island are fairly well supplied.

The results obtained with the experiment plots in the country districts show that manures are beneficial and remunerative in the establishment of young cocoa, and that pen manure, when obtainable is likely to give the best results. Observation shows that good general results are likely to follow the intelligent use of the weeds growing in a cocoa orchard. When the country experiment plots were first laid out in Dominica, attempts were made to keep weeds down thoroughly by a system of clean weeding. The soil showed signs of deterioration, but on altering the method of treatment, allowing the weeds to grow to a moderate height, and then either cutlassing them down, or bedding them in with the fork, surprisingly good results followed.

Mr. R D Anstead then read the following paper, reviewing experimental work with cocoa that is in progress at Grenada, of which island Mr. Anstead is Agricultural Superintendent.

In Grenada, experiment plots of cocoa are of two kinds, distinguished, for the sake of reference, by the terms 'experiment plots' and 'experiment stations.'

The experiment plots, as was explained at the last Agricultural Conference (*West Indian Bulletin*, Vol. VI, p. 66), are each about 1 acre in extent, and are chosen from land near the public roads, belonging to peasant proprietors.

The experiments carried out upon these plots are conducted by the Imperial Department, and are designed to run for three years, the cost of them being defrayed from Imperial funds.

The results obtained by means of these plots are highly satisfactory. The Agricultural Instructor uses them as a rendezvous when he is in the district, and as demonstration plots. Here he is able to meet the peasants, and to show them how agricultural operations, such as forking, drainage and pruning, should be carried out, and how manures should be applied.

Considerable interest has been taken in the plots by the neighbouring peasants, and the operations carried out upon them are imitated to an encouraging extent. The plots were originally chosen in poor areas, and where trees have been considerably neglected, in order that the benefits of scientific treatment may be the more marked. A good crop serves as an excellent object-lesson to all cultivators of cocoa, and indicates how the most satisfactory results are to be obtained. This year, for instance, from a plot 1 acre in extent, the owner has picked two-thirds of the total yield of cocoa usually derived from 5 acres of land.

With regard to the actual results of the experiments, figures are kept as accurately as possible, and published from year to year in the Annual Report of the Botanic Station; but from a purely experiment point of view, and as a means of obtaining accurate numerical results, the second class of experiments—the 'experiment stations'—should afford better opportunities than the experiment plots, since they are on a bigger scale and are run more on estate lines.

These experiment stations are established on large estates and consist of not less than 5 acres, or 1,000 trees. The cost of the experiments is borne by the owners, the Imperial Department supplying scientific advice as to the experiments

and the manner in which they should be conducted. These stations, of which there are at present five, have become very popular, and next year a number of others will be startod.

The result of establishing them has been to make the larger proprietors take a lively interest in scientific experiments carried out on their own estates—experiments designod to answer questions and solve problems connected with their own soils and conditions.

It is as yet too early in the history of these experiments to bo able to give, with any confidence, numerical results, but two facts are already apparent: firstly, that cocoa grown on the heavy red clay soils of Grenada rosponds quickly and liberally to the applications of lime; and secondly, that pen manure, when applied in heavy dressings and thoroughly and deeply forkod in, is of considerable valuo, and gives results that compare very favourably with mineral and chemical fertilizers.—*Agricultural News*, Feb. 22.

MR. KELWAY BAMBER'S NEW PROCESS OF PREPARING RUBBER.

Of great interest to rubber planters in Ceylon will be that rubber biscuits prepared by Mr. Kelway Bamber's new process sold for 4s. per lb. on 3rd April. This beats the price (3s. 10s. por lb.) given for some very pale oven biscuits from Warriapolla on March 6th, which was the highest figure obtained for plantation rubber since the early part of January this year. The event marks a new era in the preparation of Ceylon rubber for the market. Mr. A. Bruce, B. Sc., Mr. Kelway Bamber's assistant in Ceylon, courteously informed us that the biscuits were ordinary rubber biscuits prepared by a special process of manufacture, which rendered them perfectly pure and nearly as clear as glass in appearance. Already several estates in Ceylon are manufacturing their biscuits by this process, and such biscuits have been topping the market in price all round. The process, which is a simple one, may possibly not be patented, but planters can of course learn all about it by consulting the firm in the ordinary business way. Meantime we congratulate Mr. Bamber on being the means of placing this advance in the method of preparing rubber within reach of rubber planters and giving the plantation rubber industry yet another advantage over its competitors in the West.

CIGARS FROM LONDON GROWN TOBACCO.

We extract the following remarks from our contemporary, *Tobacco*: "Cigars made from Tobacco actually grown in London appear an impossibility and an absurdity; but in reality they are neither. A portion of the 1906-7 London Tobacco crop, grown experimentally at Regent's Park for tho last International Tobacco Exhibition, has been manufactured. The plants were shown at the last Tobacco Exhibition—at the next, which takes place on the 21st inst. at the Royal Horticultural Hall, the cigars themselves will be shown. For tho first time a representative selection of commercial seed from Cuba, America, Germany and other Tobacco growing countries has been brought to maturity on English soil. Tobacco growing is looming large just now as a first-class problem for Parliament. Ireland has wrested her charter of liberty in this respect from the Government; Scotland has already put forward a Bill for similar emancipation. And now, after all this, we have at one sweep the London-grown and London-cured leaf and the cigar manufactured therefrom. These cigars, let us hasten to add, are smokable, though a certain measure of patriotism and London pride is required to rise to the level of their aroma and taste. But one thing they are, and that is honest. They may be described without offence under the Merchandise Marks Act as the 1906-7 London crop, and as English all through, wrapper, 'bunch,' and filler. In order that the British public may see what London can do in the way of Tobacco growing, it has been arranged to make a special exhibit of these cigars at the Tobacco Exhibition as part of a display in which the pick of United States and Colonial leaf will also be included. They will be labelled Flor de London."—*Gardeners' Chronicle*, March 14.

MANURES FOR VINES: ANXIOUS.

Nitrate of soda and sulphate of ammonia supply immediately available nitrogenous plant-food, while sulphate of potash and superphosphate supply the mineral elements only. Bone meal supplies both phosphates and a little slowly-acting nitrogen. For vines mix together one part sulphate ammonia, two parts sulphate potash, and threo parts superphosphate, and apply at the rate of ½ oz. per square yard once a week from the time the latorals are 1 foot in length until the borries begin to colour. The mixture may be sown on the surface and watered in with a weak dilution of drainings from the cow-shed. Each watering after the Grapes are set should he sufficient to pass through the soil and drainage. When vines are in a strong, healthy condition and heavily cropped, and it is doubted whether the berries will finish perfectly, a good external watering of cowshed drainings through a liberal mulch of rotten manure very often turns the scalo in favour of the Grapes. Immediately after the Grapes are cut, both the external and internal borders should receive an application of bone meal at the rate of 1½ ozs. per square yard, to be lightly forked in. The vines will also derive great benefit from another mulching of short manure or decaying leaves to keep the surface moist during the autumn months. For Peaches, lightly fork into the border during winter or very early in spring a mixture composed of two parts bone meal, one part sulphate of potash, and three parts superphosphate, to be given at the rate of 4 ozs. per square yard. When the Peaches are set, and the trees are in free growth, a liberal application of diluted cow-shed drainings should be given every evening, as the roots then have the benefit of a cool, refreshing bath, extending through-out the night. At this stage of growth, and more especially if the weather is warm, it is not easy to water a properly-drained tree too liberally.—*Gardeners' Chronicle*, March 4.

A GREVILLEA ROBUSTA QUERY, CANKER IN CAMPHOR TREES.

Pykara Falls estate, Nadewatam, Nilgiris, S. India, March, 23rd.

SIR,—Can you please inform me whether the *Grevillea Robusta* is a "deep feeding' or superficial feeding tree? Has it been ascertained definitely what the nutritive value of its litter is? Have any of your readers noticed the tendency to a kind of canker in the larger branches of the camphor tree? I have never observed any disease in the main stem of the canker, but only in the branches. Will Mr. Kelway Bamber kindly permit us to benefit by his observation on this subject? Perhaps, it is not true canker, but simply the result of some injury. I have noticed the dying of individual branches frequently, but the mischief does not spread to adjoining branches. I have never been able to ascertain the cause.—Yours faithfully,

TEAMAKER.

NEW MACHINE FOR TREATMENT OF HEMP.

A new scutching machine, designed by a German engineer, is very favourably noticed in a report to Washington by the American Consul at Chemnitz, although apparently he has no information respecting the details of the invention. According to the Consul's account the machine can successfully replace the usual manual operations and not only substitute mechanical power for human effort but preserve uninjured the finer fibres. The machine has been constructed by a prominent firm at Magdeburg, and recent experiments have been conducted upon Manila hemp grown in German botanical gardens. The results have been so satisfactory that the constructing engineer is about to proceed to German East Africa with the machine and test for several months its full adaptability under colonial conditions. The *Musa textilis*, of the Philippines, has been introduced to German East Africa and flourishes there, but botanists have found that the *Musa ensete*, which yields a fibre fully equal to the famous Manila hemp, is indigenous to the colony. The only difficulty encountered in this connection with the development of this tropical industry has been the lack of suitable machinery for the scutching or liberation of the fibre from the soft *perenchyma* which encloses it and from the tissues of the bark. The operation of scutching as practised in the Philippines is of the most primitive nature. The crude process of rubbing, beating and shaving used in the Islands gives fairly good results, as far as the production of the coarser grades is concerned, but it is destructive of the finer and more delicate fibres, not only of the Manila hemp plant, but also of several other monocotyledons, particularly of the pineapple, the leaves of which yield a choice grade of fibre. The invention is also said to be adaptable for tho sisal hemp of Mexico, the economic importance of which is increasing steadily.—*Commercial Intelligence*, March 11.

TEA IN KATHA.

It may not be generally known that a large number of tea gardens are to be met with scattered throughout the Katha district, the more important gardens being in the Western hills of the Pinlebu township and in the south and east of the Banmauk subdivision and as the mode of cultivation is peculiar only to this district inasmuch as it differs generally from the usual recognised practice noticeable in tea gardens elsewhere. a brief description of the cultural operations and the method of manufacture may perhaps be of more than passing interest. It may be stated at the outset that the tea gardens are individually small in extent, being usually about an acre in area and as a rule the gardens appear to be one large plantation, but each owner knows the number of trees that belong to him.

In selecting a site for a gard n, a cool and wooded spot well sheltered from the sun is chosen preferably on the north or east side of the hills bordering on the paddy fields so that the water may drain quickly. Some holes two or three inches deep and about 9 inches apart are dug in the ground into which seeds, 15 to 20 in number, are dibbled in and they are covered over with a layer of loose earth over which some leaves are sprinkled. There is no recognised time of sowing; the seeds are generally put in just before the rains set in, but seeds are also planted in the cold weather in which case the shoots spring up early in the following rains and in either case no care whatever is given to the seedlings. The plants are slow growing reaching only a foot in height at the age of two or three years and the leaves are mature for plucking when the trees are between 5 and 7 years old. As the plants grow stronger and no longer need fear the sun's rays, the larger trees among which the seeds were originally planted, are girdled and left to die. Some protection against a strong sun is, however, always required but the trees, surrounding and over-hanging the gardens suffice for the purpose. The tea bushes blossom in August and the fruit ripens in November. The seeds are sometimes eaten but more usually retained for sowing. A peculiar characteristic of these tea gardens is that trees of different ages, some mere seedlings while others fully 70 or 80 years of age, are found growing together. This is accounted for by the fact that these gardens descend from father to son and that planting is carried on side by side with existing trees by succeeding generations and as new seeds are generally sown to fill up blanks caused by the death of the older trees the ages of the trees in a garden vary considerably.

The only care bestowed on these gardens is the clearing of grass and undergrowth of weeds once a year, principally for fear of jungle fires, and the pruning of the longer branches in order to ensure a thicker and stronger growth. The trees grow to no great height and their girth is always small. They consist, as a rule, of a clump of several stems springing from the seeds planted in the same hole and the oldest are not more than 18 inches in girth. The trees are plucked thrice a year at intervals of a month between each plucking, the crop of tender leaves at the end of April when the

first plucking takes place being the best. The tender leaves are put into large baskets (*taungs*) and taken to the village. The newly plucked leaves are thrown into boiling water contained in a pot or pan set over a burning fire and stirred with two long flat bamboos serving as ladles for a couple of minutes till they become soft. They are then ladled out with a small bamboo *chin* or open basket fitted with a handle and thrown into a larger *chin*. After the water has been well drained the leaves are emptied into a rough bamboo mat and kneaded and rolled into small balls, both men and women being employed on the work. These are then shredded and spread out on a mat to dry in the sun for some fifteen minutes when the tea is immediately packed into freshly cut hollow bamboo joints about 2 feet in length. These joints are generally of two sizes, one holding a viss of tea and the other about half a viss and a rupee will fetch from 4 to 6 visses on the spot and from 5 to 12 at a distance. A joint is said to hold a viss if the bamboo is large enough to admit four fingers stretched out flat. These joints are tightly packed with the tea so as to extrude all the juice and prevent fermentation. The joint is filled up to within 4 fingers breadth from the top; a couple of jack leaves are next pressed on top of the packed tea and the joints are then closed with a layer of mango or jack bark pounded into dust or with a layer of ash dust and then buried in a vertical position mouth downwards in the ground at a depth of a few feet and left in this state for a year. At the end of that period they are dug out and are ready for consumption by the household or for sale. Tea which has not been buried for a year is scarcely ever eaten or if it is, is not appreciated. The tea never goes bad during the time it is buried nor is it subject to insect attacks, though white ants do sometimes attack only the outside of the bamboo. Tea thus pickled is eaten with salt and sessamum oil and is considered a delicacy by the Burmese. The normal outturn of tea from these gardens is about 90 visses per acre and tea is one of the main staples of internal trade of Katha, small quantities being exported to the adjoining districts.—*Rangoon Gazette*, March 30th.

RUBBER CULTIVATION IN BURMAH.—We are indebted to a well-informed correspondent for the following information:—

My experience in rubber being confined to Mergui, I find it difficult to give you an idea of the acreage planted with rubber throughout Burma; but, to my knowledge, there are about 4,500 acres in the Mergui, Tavoy and Shweggin Districts and in Rangoon, not including small holdings owned by Chinamen and Burmans—there are also plantations in Toungoo, Bassein, Amherst and Bhamo which I have heard of, but do not know the acreage. I think rubber is being tried tentatively throughout the Province, whenever it is thought it will succeed. The Mercantile firms in Rangoon appear to be interested in rubber and so do the public here generally.

From the above, we infer there cannot be more than 10,090 acres planted with rubber altogether in Burmah.

CITRONELLA OIL IN CEYLON AND JAVA.

A native gentleman, interested in the Citronella Oil Industry and export trade, has a suggestion to make as to the best means "whereby Ceylon Citronella Oil may be brought up to the high standard of Java and Singapore." His suggestion is, "that Government be requested to give over at the upset price a few thousand acres of land to be devoted to the cultivation of the Singapore variety. This will serve as a stock garden whence other planters can draw their plants, so that in course of time the present inferior variety will be replaced by the better variety with desirable results. As this venture will be of lasting benefit to the industry the person undertaking it should be given special terms of payment for the acreage he would undertake to buy: for instance, a rent per acre for so many years, with the option of buying at a fixed rate at the end of that time or payment for the total acreage in several yearly instalments." Our correspondent then names a well-known Sinhalese capitalist who would be willing to undertake the raising of the standard of Ceylon citronella oil under the above conditions; and he mentions that it is reported "there are hundreds of thousands of acres of waste land (not forest) in the West Giruwa Pattu of Hambantota District, part of which would be eminently suited to the proposed venture." This is certainly a matter that should be looked into; because anything that would lead to the utilisation of waste chena or scrub land in the Hambantota district ought to be of advantage to the Government as well as the labouring class of the neighbourhood. But we are puzzled to understand why if Ceylon citronella oil is so inferior to that of Java and the Straits, the demand for our product continues so good—and why leading European as well as Native exporters resisted the proposal of Mr. Kelway Bamber at a recent Agricultural Society's meeting to establish a new test calculated to raise the standard for Ceylon oil? Will our correspondent oblige us by giving the respective prices per ounce in Europe for Ceylon and Java citronella oil, to show the advantage of introducing the grass yielding the latter?

TRINIDAD CACAO EXPORTS.—Cacao growers in Trinidad—says the *Agricultural News*, March 7th—are certainly experiencing a favourable season and good returns for their produce, and even if prices drop somewhat before the whole of the crop has been gathered in, the increased output as compared with last year should go far to make ample compensation to producers. During 1907, a total of 251,755 bags of cacao were shipped from Trinidad, of which 134,611 went to Europe, 114,749 to New York, and 2,388 bags to Canada. In January, 1907, the amount of cacao shipped was 16,308 bags, while during the corresponding month of 1908, the exports reached 46,139 bags, or very nearly treble the output for January of the previous year.

REPORT ON COCONUT PALM DISEASE IN TRAVANCORE.

By Dr. E. J. Butler, Imperial Mycologist.

The southern half of the coconut forest of the Malabar coast lies in Travancore. Viewed from the sea near Alleppey it forms a continuous belt in which the coast villages are entirely buried. The coast line here consists of a sandy beach, passing inland into a high soil with a large proportion of sand until the shore of the Vembanad lake, a large lagoon some forty miles long, opening to the sea at Cochin, is reached. This lake forms part of the continuous system of navigable lagoons and channels, part natural part artificial, which extends parallel to the sea for a distance of over two hundred miles northwards from Trivandrum. These are for the most part narrow and tortuous but open out here and there into expanses of shallow water, the whole forming an unrivalled chain of "backwater" communication through the heart of the coconut area. Around the lagoons and backwaters the soil is stiffer than along the coast, largely formed of silt taken from the bed of the water-channels and employed to build up small islands and banks, raised a foot or two above the water level, crowded with coconuts and densely populated. In parts of the east and south-east of the Vembanad lake low ridges of laterite are found. In this tract between the sea and the backwaters and around the latter except on the laterite, the best coconut lands of North Travancore are found. Practically only two types of

CULTIVATION ARE SEEN IN THIS AREA.

By far the larger portion consists of coconut gardens, with areca, jack, plantain and other garden produce as subsidiary crops. In the shallow stretches of water, broken by coconut topes, which border the lake and open out of the backwaters, a peculiar type of paddy cultivation is seen. These stretches are enclosed by mud and wattle bunds built from the bed of the lake to near the surface of the water in the monsoon, and the surplus water is pumped out by steam or hand power until a crop of paddy can be put in. The pumping is done after the north-east monsoon, the crop planted about December and harvested just before the inundation of the following south-west monsoon. Inland from the backwaters is a tract of country extending to the foot of the Cardamom hills, which form the western half of the State. This is broken by numerous rivers and streams descending from the hills to empty into the backwaters and ultimately the sea. It is not flat, like the coast belt, but diversified by low hills and ridges, particularly towards the higher range. Coconut cultivation follows the rivers and streams, the palms being found not only in the valleys but also on the hill sides. It is possible therefore to distinguish three more or less distinct zones of coconut cultivation: the littoral, with sandy soil not much raised above the water level and comprising the largest part of the area under coconuts: the part adjoining the backwaters, equally low-lying but with soil largely formed of salt: the sub-montane, extending inland to the foot of the hills with a deep red or blackish alluvium along the valleys and a shallow, generally poor, laterite on the hills. The palm thrives best on the sand of the coast and the sandy loam around the backwaters within ten or fifteen miles of the sea. Towards the hills it is less productive; fine gardens occur in the valleys but those on the hill sides are poor. The climate of Travancore is remarkably equable all the year round. The mean day temperature of the year is about 80° F., the mean maximum of the year about 87·5° F., and the mean minimum about 75° F. Higher readings than 90° are rare, and lower than 70° still rarer. The rainfall shows

TWO WELL-MARKED PROGRESSIVE INCREASES

from south to north and from the coast-line to the hills. Thus it increases from an annual average of 30 inches near Cape Comorin in the south to 114 inches at Alleppey and 117 inches at Parur in the north of the State, and again from 114 inches at Alleppey on the coast to 198 at Peermade in the hills. There is no long dry period, rain falling as a rule every month throughout the year, though December to March is comparatively dry. January is the driest month. Precipitation increases until the arrival of the south-west monsoon. June is the month of maximum rainfall. Then there is a diminution again until October when, with the north-east monsoon, a secondary maximum is reached. As the coconut is said everywhere to require a warm and moist climate with an equable temperature, it will be evident that Travancore fulfils its climatic requirements perfectly. It is said also to flourish best sufficiently near the sea to allow of the sub-soil being infiltrated with sea water. Different analyses in India, Ceylon and the Philippine Islands seem to show that a heavy crop removes over a hundred pounds of potash salts and over sixty of sodium chloride (common salt) per acre per annum, and may explain this preference. Be that as it may, a large proportion of the best Travancore coconuts are in soil which is infiltrated with salt or brackish water. That this salt is a necessity to the tree is evidently believed in many coconut growing countries where, as in Travancore, an application of salt to its roots is frequently made. Its requirements in potash and magnesium are probably supplied in part by infiltrated sea-water in low-lying littoral or backwater soils. Elsewhere they are furnished by dressings of wood and leaf ashes (largely of the coconut itself) applied around the base of the tree. Beyond this a limited amount of manuring with coconut or other poonac, cattle manure, fish manure and occasionally bones is practised.

THE PALM RESPONDS REMARKABLY QUICKLY TO FERTILIZERS

and there is certainly much room for improvement in indigenous practices in this respect. The prosperity of Travancore—admittedly great—depends primarily on its coconut industry. It is difficult to ascertain the exact area under the palm, combined as it is with every other sort of cultivation except in the dry area of

the south, on paddy lands, and in the hills. One estimate gave about 250,000 acres under palms. The exports for 1903 were approximately a crore of rupees' worth of all kinds of coconut produce, oil, copra, coir and nuts. The internal consumption is very great. Apart from those actually engaged in palm cultivation—landholders, tenants, labourers,* etc., the coir industry alone supports 133,047 persons according to the Census of 1901. One of the densest populations in India (six of the taluks have over 1,000 persons to the square mile and three over 1,300) is maintained primarily by this palm. It is natural that any diminution of yield due to disease should have forced itself on the notice not only of the cultivators but of the State authorities. Still it is an indication of the insidious nature of the attack of the disease here dealt with that, though Minachil has been affected for thirty or forty years, it does not appear to have been brought to the notice of Government until much later, in a memorial from the ryots of Kaviyur and Kalloopara, dated 24th April, 1897. Even yet the serious state of affairs is not realised in many localities where it is considered a passing affliction, though the experience of the older affected localities, such as Minachil, should serve as a warning. The extent of the damage already caused by this disease may perhaps be gauged by the fact that, in spite of the rise in prices in recent years, the trade in coconut produce accounted only for 32 per cent. of the entire State exports in 1905 1906, against an average for decades past of nearly 50 per cent. In the short time at my disposal I was unable to ascertain the exact limits of the area said to be affected by the disease. It is confined to North Travancore; from north to south it extends from Shertollay to probably near Quilon; inland it reaches the foot of the hills at Erattupetta. The total area affected is, however, unknown.

THE EARLIEST RECORD OF THE OUTBREAK

that I could obtain was at Erattupetta in Minachil taluk. Here it was variously stated to have commenced thirty or forty years ago. In so remote a period the cultivators' recollections are likely to be mere approximations; still it is certainly of more than thirty years standing. From Erattupetta it spread slowly westward to Minachil, Lalam and Pulliyanur. The latter is said to have first got the disease above twenty-five years ago. Further to the west it is still spreading slowly in a continuous line; a village about seven miles west of Pulliyanur was, I was told, reached only two years back. At the same time outbreaks occurred in many other parts of North Travancore. At Changanacherry I was told it had been noticed about twenty years ago, but some gardens have been attacked within the last two years. At Alleppey, where it is confined to a small area, it was also first observed about twenty years ago. In each case after the first outbreak in one garden, neighbouring gardens have been successively attacked, and everywhere seen, there were the same indications of gradual spread from one or a few original centres of infection. Besides coconut several other species of palm are attacked. The areca palm is even more severely affected at Minachil and opinions were unanimous there that this was the first variety to become diseased. The talipot (*Corypha umbraculifera*) is not nearly so common as these two, but several cases of disease in this palm were brought to my notice. Similarly the sago palm (*Caryota urens*) is sometimes affected. I heard of no case in palmyras. In the others the symptoms are alike, and there is no reason to doubt that all suffer from the same disease. The symptoms are those of a slow and progressive deterioration of the palm, in sharp contrast to the rapidly fatal palm disease of the Godavari Delta on the West Coast. They are not always developed in the same order and some, such as an exudation of gum from the trunk, are only occasionally found. As a general rule the first indication that

A COCONUT PALM IS ATTACKED

is the opening out of the outer leaves from the head. The leaf stalk becomes slightly flaccid and the weight of the leaf causes the whole to droop. Then the ends of the pinnae or leaflets at the extremity of the leaf become flaccid and hang down almost vertically. This is accompanied by a loss of colour; the drooping and discolouration of the leaflets then extend gradually backwards to the whole leaf. Later on the tips of the leaflets turn yellow and dry up, followed gradually by the entire leaf, which eventually hangs down withered from the crown. The attachment of the leaf sheath to the tree is weakened so that the outer discoloured leaves can be easily torn off from the crown. One after another, or many together, all the leaves are similarly affected; intermediate conditions are common, young trees often have a large proportion of leaves healthy with only a few yellowed, others have all the leaves equally discoloured and drooping at the tips of the leaflets, before any dry up. Gradually, as the palm weakens, new leaves that are put out are smaller than of old. This is apparent even before they unfold from the bud, and results in the central or leading shoot, which is merely the unopened new leaf bud, becoming stunted and pallid. Later on it begins to wither and the upper free part turns brown. Eventually it may dry up altogether, but this may not occur for many years. Even in the first year or two

THE NUTS ARE AFFECTED.

They are fewer and smaller than usual. On splitting, the husk is found unaltered and usually the shell also. The white kernel is, however, shrivelled and indurated and copra prepared from it is said to be deficient in oil. The fluid inside is reduced in quantity (or even I was told sometimes absent, though I did not see any such case) and is altered in quality, becoming unpalatable to drink. In later stages a large proportion of the nuts drop in an immature condition. In more severe cases the spathes are unable to burst out at all or, if they do, rot away early and the palm becomes barren.

In healthy palms a bunch of nuts is given about every two months. The best trees in the submontane districts yield about sixty to eighty nuts a year. Nearer the coast the yield may rise to eighty or hundred, though the average is much lower. I was shown one fine palm that

gave, up to a year or two ago, an average of twenty nuts per bunch; it is now diseased and gave this year only three or four. The top of the stem and the white internal part of the crown (known as the "cabbage") are quite normal, except in old cases, just before death, when the latter rots. Even in severely affected palms no trace of the disease or of any unhealthy condition can be found in these parts. The rest or the stem is equally healthy in appearance; I was told that wood from diseased trees is weaker than from healthy and it is certainly more spongy in texture. In some cases cracking of the rind with exudation of gum occurs in the early stages; it is not a general sympton but only seen in a few cases. As in palms everywhere, discoloured patches on the rind are frequent, but they are mostly superficial and entirely unconnected with the disease. A brown discolouration frequently appears after cutting open the trunk. This is apparently more marked in diseased than in healthy trees. It is not visible when first cut, is quite unconnected with any parasite and is probably due to an oxidation process.

The absence of any parasite in the stem is of interest. A coconut disease similar in many respects to the Travancore disease has recently engaged attention in Ceylon. It has been attributed by the Government Mycologist, Ceylon, to a fungus known as *Thielaviopsis ethaceticus*, well known as the cause of the "pine-apple disease" of sugarcane. A similar fungus occurred with such regularity on the cut stems of coconut palms wherever examined in Travancore that the likelihood of its being the cause of the disease appeared considerable. Further investigation showed that this is not the case. The fungus though allied to the cause of "pine-apple" disease, is a distinct species of *Thielaviopsis* It occurs equally on healthy and diseased palms and on all or most of the Indian species, being common on coconut, areca, palmyra and date. It is found on cut surfaces of roots, stem and crown and appears freely on split areca nuts that are perfectly healthy. Hence its spores must be very widely distributed on the surfaces of palms, and in the air in palm-growing tracts. As it

LENDS ITSELF EMINENTLY TO RAPID DISSEMINATION

this fact alone would be enough to put it out of court as a cause of the disease, for the progress of the latter is extremely slow. Even more definite evidence is fortunately available. It occurs equally freely on palmyra and date palms at Pusa where no serious palm disease is known. It has also been encountered in Sylhet on areca palms, in the Godavari on palmyra and coconut, and on date palms from Sind. In none of these areas is there a similar disease to that in Travancore. Further slabs of the stem of diseased coconut palms in Travoncore were cut out with a red hot knife under asceptic precautions and incubated. These did not give rise to any fungus when kept from exposure to the air, though when uncovered they quickly showed a characteristic growth of *Thielaviopsis.* Hence whatever be the cause of the Ceylon disease, the palm *Thielaviopsis* is a perfectly harmless fungus in India, so far as is at present known, and certainly has nothing whatever to do with the Travancore disease. After the leaves, the most extensive alterations are found in the roots of diseased palms. As the roots themselves show differences in the sandy soils of the littoral tract and the heavy alluvium of the inland valleys, they will be separately described. In the sandy soils of the coast and the light silts of the backwaters the main roots extend both downwards and laterally for great distances. For most of their course they are unbranched, finger-like structures, covered with a reddish bark, usually straight and gradually diminishing from three quarters of an inch or more to half an inch or less in diameter. From their structure they must be considered to be primarily "fixing" roots, whose chief function is to fasten the tree into the soil. Water and food-suplies taken in by the feeding roots must pass to the stem through them, but it is improbable that they themselves play any part in obtaing supplies. From these main roots the lateral roots are given off at intervals, and from the lateral roots finer rootlets arise. The roots of the second and third order are small, white, softer and less brittle than the main roots and appear to extend only a short way from the parent root.

FOOD AND WATER ARE TAKEN IN

by the finer rootlets, which thus have functions of the highest importance in the economy of the tree. In the heavy alluvial soils of the submontane area the roots do not run to anything like the length of those in sandy soils. The main roots are smaller, much curved and twisted and frequently branched. The lateral feeding roots are given off closer together and are better developed than in the other case.

In the sandy soils food-supplies are scanty. As are sult an effort is made by the tree to tap as large au area as possible. It can hardly be doubted that this is the explanation of the long exploring roots of palms in the littoral tract. The valley soils of the interior are, on the contrary, rich in organic matter washed down from the hills and food is present in sufficient quantities near the base of the stem. Hence there is no need for the penetration of a considerable bulk of soil and the roots mass and ramify in a comparatively small space. In consequence of the larger expanse of roots an examination of the entire root system of any but seedling palms is practically impossible in the sandy area. The following account is therefore based chiefly on conditions observed at Pulliyanur in deep valley soils; such examination as was possible at Alleppey on the coast was only sufficient to show that the essential features are the same. In seedling coconut palms the main root arise densely crowded together from all parts of the swollen base of the stem, and diverge in every direction. Each main root gives off numbers of white lateral roots, which again give off others of the third order. Except in advanced cases of disease, the main roots of a diseased tree will be found for the most part unaltered. A large proportion of

THE LATERAL ROOTS ARE HOWEVER ROTTED

and, in some cases, this rot extends back into the main roots and even to the base of the stem. In some advanced cases

of disease half of the main roots were found to be affected with this rot while the proportion of the smaller roots rotted was much higher. In milder cases only three or four main roots maybe rotten while, even on the sound roots, perhaps fifty per cent of the rootlets will be dead. The disease therefore manifests itself chiefly through alterations produced in the leaves and in the roots and it is necessary to ascertain in which of these parts it has its original seat. In the leaves the wilting and discolouration of the leaflets are not induced by parasitic attack. The leaf tissue simply gets pale and flaccid. Even when this extends to the whole leaf there is still no indication of any local parasite at work. The condition is merely one of starvation and drought. When the leaf ends die, no doubt fungi appear, but fungi always fasten on any dead plant tissue and an examination of those found showed that they were common moulds and harmless species, feeding on the dead tissues. The minute plants known as fungi are as a whole divided into classes according to their food requirements. The larger class, the *saprophytes*, live on dead organic matter, chiefly plant remains; they cannot get their food from living tissues such as growing plants. The smaller class, the *parasites*, are on the contrary able to attack and feed on living tissues, and are the cause of a vast number of diseases of plants. On the leaves of diseased palms no parasite was commonly found such as would be sufficient to account for their unhealthy condition. Were one present we would expect to find the first attack confined to one or several small areas, whereas in fact a large number of leaves may

TURN YELLOW AND ALL THEIR LEAFLETS BEING TO DROOP SIMULTANEOUSLY.

In the roots matters are different. The root itself consists of an outer layer of thick-walled cells which forms a protective covering. Within this there is a zone of variable thickness, composed of cells with moderately thick walls which become larger, looser and have thinner walls as they are further from the surface. This is known as the *cortex*. Within the cortex, and forming the central tough strand of the root, is a body of mostly thick-walled cells called the *central cylinder*. It is through the latter that the vessels run which convey water and food salts from the soil to the stem. Lateral roots affected by the rot mentioned above are invaded by a parasitic fungus, which enters from the soil and develops the minute threads of which its body is composed in and between the cells of the cortex. When a root becomes invaded by this parasite the cortical cells are killed as soon as a thread of the fungus reaches them. They quickly turn brown and collapse. This is especially marked in the large thin-walled cells of the inner layers. At a later stage the whole root appears blackened and shrunken as a result of the death of a large number of its cells; it can evidently no longer perform its work of taking in food, and decomposition rapidly sets in. The threads of the parasite are of two kinds. The older ones are deep brown and comparatively large. From them arise finer colourless branches. All are divided into segments by transverse walls. In older stages masses of these brown threads become crowded together and divide frequently, so that a brown patch of fungus tissue is formed. In this, at a still later stage, spore capsules are developed under the rind and these burst out to open on the surface of the root and discharge spores.

THE SPORES ARE RATHER LARGE, EGG-SHAPED BODIES,

colourless and single when young but divided into two cells and deep brown when older. It is a species of the genus *Botryodiplodia*, of which several parasitic members are known. Quite recently Mr. F A Stockdale, Mycologist to the Imperial Department of Agriculture, West Indies, has described a similar and perhaps identical species as the cause of a serious coconut disease in Trinidad. The symptoms of this disease are on the whole similar to those described above and it appears to be possible that both are really the same. There is no absolute proof that the *Botryodiplodia* is the cause of the disease either in Travancore or in Trinidad. It is not even certain that the two are identical, as the scientific description of the latter has not been published. So far as can be gathered from Mr. Stockdale's report the spores of his fungus were not found actually on coconut roots, but only on the leaf petioles, though he attributes the death of the roots to a fungus found in them and apparently agreeing with that on the petioles. In Travancore the *Botryodiplodia* was only found on roots but was obtained on diseased roots of areca as well as coconut palms. Spores were not found on roots actually in the soil but developed on diseased roots after these had been dug up and kept for some time. Only the early stages of formation of the spore capsules were found in freshly dug roots. The brown threads within the roots were found in these cases to communicate with the spore capsules, both immature and ripe and there is no doubt that the threads of diseased roots belong to the *Botryodiplodia*. Scientific proof that this fungus is the cause of the disease can only be obtained by inoculating the roots of healthy palms with a culture of the fungus and

THEREBY PRODUCING THE DISEASE.

This has not been possible in the time at my disposal and would require facilities for isolating and growing the fungus which were not available in Travancore. All that can therefore be safely said is that the roots of diseased palms are rotted by the attacks of a parastic fungus; that this fungus appears to be a *Botryodiplodia*; and that probably the root rot caused by it is sufficient to produce the disease at present ravaging the coconut gardens. The effects of such a parasitic attack on the roots will be at once clear if we consider the work which healthy roots have to perform. For healthy growth a tree requires a supply of carbon dioxide and oxygen from the air, and water with dissolved salts from the soil. The latter are useless to the plant until they are carried up to the leaves, where they become transformed into food. For this purpose a steady flow of water containing the salts in solution must be maintained between the roots and leaves. The surplus water at the top is got rid of by "transpiration" or evaporation into the air. Besides its use n

carrying salts to the leaves, an abundant supply of water is required in every part of the plant body to keep the body cells in activity. All the water required by a plant is taken in by its roots. The roots which do this work are for the most part not the main roots but the finer rootlets. As we have seen above a large proportion of these are found to have rotted in disease trees, with the result that the water-supply is diminished. In a tree such as the coconut palm the effect of this would naturally not be evident in the stem, but would be visible first in the leaves. This accounts for the early symptoms of drooping of the leaflets and

FLACCIDITY OF THE LEAF STALK

so that it bends away from the crown. At the same time interference with the food-supply causes the leaves to lose colour. The yellowing of the crown which is the most evident symptom of the disease is thus due to the combined effects of drought and insufficient food. Hence it is that though an appearance of recovery is said to be frequently visible after heavy rain, the effect, as it is only due to a temporary increase in available water, disappears as rapidly as it came. The period of fruiting of a tree throws a heavy additional strain on its resources. This is chiefly in the matter of food-supply. Hence unless the feeding mechanism of the tree is in perfect order the fruit is not properly developed. For the first season or two of scarcity the roserve resources possessed by every tree may be sufficient to allow a fair proportion of fruit to ripen. This, however, is only done at the expense of the "capital" of the tree and in reality hastens its deterioration. Later on food becomes insufficient for any formation of fruit and the tree becomes barren. This is exactly what happens in coconut disease and is made manifest first by a diminution in the number of nuts on each bunch, then by their dropping while immature and finally by their entire absence. As a larger number of leaves become incapable of performing their proper work of manufacturing food, the leading shoot becomes stunted. The still unexpanded leaves of the bud turn yellow and dry up at the extremities. This withering extends backwards until, in extreme cases, the bud itself withers, rotting sets in and the crown falls off. Such a termination may not be reached fo: years; localities, such as Alleppey, where disease has existed for twenty years, have as yet had comparatively few deaths. Palms of every age are attacked. In Minachil numbers of diseased seedlings a year or two old were found. Very old palms appear to escape longest, probably on account of their large root area. Still I saw a few trees, said to be about

A HUNDRED YEARS OLD, WHICH WERE UNDOUBTEDLY DISEASED.

The intensity of the disease differs greatly in different localities. In the sub-montane area around Minachil death is a frequent termination. In Alleppey and Changanachery deaths are rare. In the former the attack first began in areca palms and subsequently extended to coconuts. It spreads most rapidly and is still most severe in the low-lying, badly drained lands along tho valley of the Minachil river. Gradually the hill-side gardens were attacked, until at the present time scarcely a garden between Erattupetta and Pulliyanur is free from it. In areca palms it runs its course more rapidly than in other species. This is probably due to a variety of causes. In the first place there is little or no attempt at cultivation in the areca gardens. The nuts are self-sown and come up densely through a heavy undergrowth of weeds. They appear to receive little attention at any period of their growth. The palms are very close together, six or eight hundred to an acre. They are smaller and probably more delicate than the coconuts. All these circumstances favour the disease and it spreads rapidly once it gets a footing. In one garden visited, only thirty areca palms had survived out of six hundred. Death has been known to occur in three years from the first attack, but the usual period is five or six years. In coconuts young palms may bo killed in five years, but this is exceptional. Eight or ten years appears to be a more usual period, while in very many cases the disease progresses enough to cause barrenness, but fails to kill the tree outright. Thus in one large garden only two hundred coconut palms were in bearing out of about two thousand, whilo the actual deaths were not numerous. Recovery in either areca or coconut palms, once they have taken the disease, is said to be unknown near Minachil. Near the coast at Alleppey very few trees have been killed. The area affected here is an almost continuous block of about twenty five acres in extent. In part of this somo proprietors have seventy or eighty per cent of their palms diseased. Here coconuts were first attacked and areca palms, which are less grown, subsequently. I was shown several palms which have been

DISEASED FOR MORE THAN TEN YEARS WITHOUT SUCCUMBING.

As regards recovery opinions were conflicting. In some cases a progressive recovery lasting for five or six years was said to have occurred. Others said that such recovery was temporary and that the palm never succeeded in entirely throwing off the infection. At Changanachery in the backwater tract the disease was similarly of a mild type as compared with Minachil but was widespread. Deaths were rare but the loss in yield in individual gardens was over 50 per cent. A temporary recovery had been obtained by one man who applied lime to the roots; this only lasted for about two years and the yield again dropped. Hore, as at Minachil, low-lying lands were most severely attacked, but gardens on higher land were not immune. Where the soil is sandy, the progress is slower than on laterite. The above account shows that the disease is worst in the heavy alluvial valleys and poor laterite hill soils on the sub-montane tract. It is widely distributed but less severe in the neighbourhood of the back waters being apparently worst on poor laterite ridges and badly drained hollows. It is least severe on the sandy soil of the littoral.

Spread has probably occurrod from one or a few centres which were early attacked. The evidence

points to Minachil taluk as the locality of its first appearance. The extension in this taluk has been continuous from Erattupetta towards the west. At the samo time other outbreaks occurred in isolated places such as Alleppey. The question of the infectious nature of the disease is therefore of great importance since, if it has succeeded in crossing the Vembanad Lake, thore appears to be no reason why it should not eventually spread all along the Malabar Coast. The disease is undoubtedly infectious. All the evidence points that way. For instance the steady gradual extension from east to west in Minachil taluk can have no connection with conditions of soil, climate or anything of that sort; it must imply the march of some infectious matter. Similarly the small diseased area at Alleppey is gradually extending but forms a solid block, while to the north, east and west there is none for miles. The best evidence, however, was got in a garden about half a mile south cf the main area of disease at Alleppey. About ten years ago a palm was purchased from a garden in the latter area and transplanted into this garden. It was disoased at the time but the purchaser did not at once realise this fact. None of his other trees were in any way unhealthy at that date. Some few years after, however, the palm next the newcomer began to turn yellow, and this was followed by others near by. Now there are thirteen palms affected all near together, while the original one has died and been removed. It has not remained confined to this garden but some five or six others adjoining have each a few cases of disease. There can be no possible doubt that the infection of this locality was the direct result of introducing a diseased tree and planting it amongst healthy ones, and the owner himself firmly believes this. The practice of transplanting palm trees is apparently not rare. If a site has to be cleared for building a house, the palms occupying it are frequently sold by auction. Even large trees are said to be purchased in this way, and are removed with a mass of soil around the roots to a new locality. Where a root disease exists nothing could be more dangerous than this practice, for the infectious matter is introduced into healthy soil and gets a strong footing there. How tho disease has reached palms situated at a distance from its original starting-point, without affecting those in between, is not clear. There must be few parts of India with a greater internal movement of population than Travancore, judging from the boat traffic on the backwaters, and into Alleppey. It appears probable that the germs of disease have been conveyed from place to place by water either on raw coconut produce or in some other of the many conceivable ways. It must be remembered that the transport of a small quantity of soil or a few cocount roots from a diseased to a healthy garden might readily lead to infection of the latter. It appears probable that no other means of spread exists than from root to root through the soil. Many fungus diseases of plants are disseminated by spores blown through the air. A well known instance of this, in Travancore, is the coffee leaf disease. Such blights are characterised by the rapid way in which they spread over the whole of the country where conditions favourable for their existence occur. Every coffee-growing part of South India was attacked in the few years following 1869 when leaf-disease first appeared. It is evident that the greater part of North Travancore is suitable for the growth of the cocount root parasite, since outbreaks have occurred in so many localities. Hence the slow spread of the disease and the fact that many parts of the coast belt have not yet been affected suggest the absence of air-borne infection. The parasite has only been found on roots below the soil level and, even if spores are formed, they could not easily reach the air. Extension through the soil, however, almost certainly does occur and is practically the only way in which the conditions described above as found at Alleppey can be explained. The spread of a fungus in the soil depends a good deal on soil conditions. Cultivation hinders it, owing to the disturbance and consoquent aeration of the upper layers of soil. Imperfect drainage is frequently found to intensify root diseases, probably both because sodden soils allow a more active growth of the parasite and because root development is less in such soils. Drought probably injures both parasite and hostplant, but the latter most, as its damaged root system cannot cope with the demand for water unless moisturo is plentiful. In the dry season the leaf symptoms in the Travancore palm disease are at their worst but a severe drought, which would probably cause a heavy mortality in diseased palms, is not likely to occur in North Travancore. On the whole the evidence is that heavy, ill-drained lands suffer most. In these, especially in clay soils, the growth of the roots is checked; those that rot away are not readily replaced by new ones; the attempt is made, but the new roots are feeble and unhealthy from the start. The most difficult of all fungus diseases to check are thoso which affect the roots of plants. The parasite wh ch is the proba le cause of coconut disease in Travancore enters into the tissues of the living roots and is out of the reach of any direct treatment. No ready cure can, therefore, be looked for. Any application which would kill the parasite must be taken up by the roots; with few exceptions these would also kill the roots and do more harm than good. There are other methods however by which we may hope to lessen its ravages and these will be considered in order.

1. The Eradication of the Disease by Destroying all Diseased Material and so Preventing Infection of Healthy Palms.—This is the method which is being employed in tho palm disease prevalent in the Godavari district of the East Coast. In the latter, however, the limits of the disease are well defined and are not very extensive. The diseaso itself is confined to the "crown" and it this is cut off and burnt, all infective matter can be destroyed. In Travancore the disease is scattered throughout a much larger area than in Godavari. Much greater numbers of individual palms are affected and, even were the disease confined to the crown of the tree, it would be a work of great magnitude to attempt to eradicate it by burning all diseased crowns. As in fact such a measuse would be useless unless the roots of

diseased trees were also dug out and burnt. this method appears to be entirely out of the question as a general procedure. In a certain number of cases the method of eradication can, however, be adopted. When disease first appears in a new locality there should be no hesitation in applying it. A large number of individual outbreaks appear to have occurred in parts not immediately adjoining a previously diseased area. All Taluk officers should be instructed to watch for the first appearance of disease in any part of their charge not bounded by a diseased area and to take prompt steps to have diseased trees dug up and burnt. There will be many difficulties in the way in carrying out this suggestion. Newly affected palms continue to yield for some years. The owners will naturally oppose their destruction as long as is a prospect of obtaining any crop from them. This feeling can be lessened if it is pointed out, by means of widely distributed vernacular leaflets that the disease is infectious and that measures to prevent its spread are undertaken in the interests of the ryots themselves. If detected in the early stages probably only a few palms will have to be destroyed. Even where a whole garden or a small group of gardens is found to have the disease, the interests of the few should be sacrificed to those of the many whose gardens are still free. In considering this method of attacking the disease it must be clearly borne in mind that there are two quite distinct sets of circumstances. In the first place there are large and continuous areas of disease such as that in Minachil taluk, around the margin of which a steady continuous extension is going on. It is questionable if any drastic remedy such as removing newly diseased trees is practicable along the margin of spread. It is probable that nothing short of clearing a belt of palms in front of the disease would prove effective ; reinfection from the diseased area would be likely to occur as long as any healthy palms remained near by. I am not inclined to suggest so large an undertaking. In the second place there are numerous isolated outbreaks occurring away from previously diseased localities. These, if detected early, can be dealt with by the method of extermination, at comparatively small expense and with a loss that will be repaid many times over by the palms thereby preserved. Diseased palms of all kinds—areca, coconut, talipot, sago and possibly palmyra (if it should be found to get the disease) should be removed. After digging out the roots the hole should be well limed and the earth turned over at intervals for a period of about a year to destroy any remains of the fungus. Replanting can then in all probability be safely undertaken. Only the root and base of the stem below ground need be burnt. After digging up they should be split into pieces, if necessary, and built around with plenty of dry palm leaves or something of the sort to give an intense heat when fired. On no account should the excavated roots be left lying about, for there is a danger of spore formation taking place on the surface and consequently of dissemination through the air. They should be burnt within a few hours of removal.

I believe that it is only by the most energetic action in this direction that there is any chance of checking the spread of the disease to hitherto unaffected parts. Every new outbreak serves as a focus from which a gradual but apparently inevitable spread takes place. No part of North Travancore is immune, and it appears to be merely a matter of time before the whole area becomes attacked. The outbreak at Alleppey shows that even the coast belt does not escape, and there has been no diminution but on the contrary a steady progress there for the past twenty years. The area now affected (about 25 acres) is sufficiently defined to make it a good test case of the value of total extermination. If compensation were necessary, the amount would not be excessive. At the same time the few gardens affected at Mukolakal, a little distance to the south, should be similarly dealt with; careful search should also be made for any other similar outlying cases. The question of compulsory action and compensation do not appear to call for discussion in this report. It is, however, probable that some form of compulsion would be necessary in carrying out the above suggestions. The staff that would be required and the manner of their recruitment must also be left to the State authorities to consider. Probably the best method of ascertaining the actual requirements would be to depute an officer to make a special survey of the diseased taluks in North Travancore. In this all localities which appear to have been recently infected, or where the disease is confined to a limited area as at Alleppey, should be shown, the distance from the nearest large area of disease indicated and a rough estimate made of the area requiring to be dealt with. To assist in an enquiry of this nature, a short description is given below of several other minor causes of ill-health in coconut palms noticed in Travancore, sufficient to enable them to be distinguished from the root disease. (2) Ridding infected soil of the parasite in order to allow of replanting.—After removing all diseased palms from an infected spot the soil should be rested for at least a year before replanting. During this time it should be "cultivated," *i.e.*, frequently stirred to break up and aerate the soil. Lime should also be added, where available as it is likely to hasten the death of any remnants of the parasite left after removing the roots. Quick-lime is better for this purpose than slaked lime.

(3) The Application of Manures or other Substances to the Roots of Diseased Palms.—A few remedies have been tried by cultivators in various places. As, however, almost all were attracted by the unhealthy condition of the crown and did not think of searching for its cause at the roots, these applications were made, for the most part, to the top of the palm. Some used ashes and lime, others maravetti (*Hydnocarpus Wightiana*) poonac, without effect. Lime was applied to the roots in a few cases and appears to have met with, at any rate temporary, success. This line of work deserves to be followed up. It is possible that the application of lime or some other substance to the roots may enable new roots to be put out and escape attack by destroying the parasite in the soil. There is an Agricultural Inspector attached to the Experimental

Farm at Trivandrum and this appears to be work which he could carry out. A small garden with sufficient moderately diseased palms for experimental purposes might be taken up, and a series of experiments planned with the ordinarily available manures, supplemented by ammonium sulphate, lime, sulphur and sulphate of iron. Each of these should be tested separately, not in combinations.

(4) Improving the General Health of the Palm.—Cultivation in coconut lands might be very greatly improved. This is particularly the case in the inland districts, such as Minachil taluk. In these, manuring is practised only to a limited extent ; draining is wholly unattended to ; cultivation is neglected. The common condition in the badly diseased gardens along the banks of the Minachil river is a dense undergrowth of weeds and low jungle, through which the palms grow as best they can. There is no drainage, though the land is low lying, heavy, and in urgent need of it. Drainage in these lands would materially improve the root development and give the plant a chance of throwing out new feeding roots to replace those destroyed. The great root development of palms on the coast soils is probably the reason why they are less severely affected by the disease. The presence of a dense covering of weeds on the soil keeps the latter badly aerated and probably promotes the growth of the parasite. Cultivation would break up the soil and may be expected to produce a directly harmful effect on the parasite, apart from improving root development. The effect of manuring on the disease should be studied. It is certain that anything that stimulates the growth of the palm will improve its resistance to the disease. It is however, possible that some manures, such as cattle manure or other nitrogenous fertilisers, may also stimulate the growth of the parasite and might do so to an extent that would more than counterbalance the improvement of the palm.

(5) Search for Disease-resistant Varieties.—A number of varieties of the coconut palm are known. Several are enumerated in Ferguson's Ceylon Manual "All about the Coconut Palm." I was not able to ascertain what varieties are recognised as distinct in Travancore nor whether any have shown powers of resisting the disease. Enquiries amongst intelligent growers might elicit valuable information in this direction. It is well known that some varieties of a plaint often resist disease much better than others, and if such a variety could be discovered amongst the coconut palms of Travancore, its value would be very great.

(6) Measures to Prevent the Introduction of the Disease to Neighbouring Territories.—There is a very large water-borne trade in coconut produce with the neighbouring State of Cochin. Intercourse with the British districts of Coimbatore on the north-east and Tinnevelly on the east is less, and there is probably little export of raw coconut produce elsewhere than to Cochin. As the latter is a large coconut grower and adjoins on the north the extensive coconut districts of British Malabar, it appears that stringent regulations are required to prevent the infection of these areas. For practical purposes it is probable that a sufficient safeguard would be provided by prohibiting the entry of living coconut plants (seedlings are, it is believed, sometimes exported) and of roots (said to be used for fuel by metal workers, and also as medicine). I am strongly of opinion that the export of these should be forbidden in Travancore and that all coming from Travancore should be declared contraband by Cochin. From the nuts, coir, oil and, in fact, all the above ground parts of the tree, no danger need be apprehended.

The following notes on some other disease of coconuts observed in Travancore are added to enable them to be distinguished from that described above. They are at present of less importance than the latter, though in the aggregate responsible for a good deal of damage. As their causes and treatment are different in each case, it is necessary to be able to recognise them wherever active measures against coconut disease are proposed.

(1) Leaf Disease Caused by Pestalozzia Palmarum.—This disease is due to a fungus which attacks only the leaves. It first becomes visible by the apperance of little transparent whitish spots on the leaves. These may be only few in number or may, in bad cases, be very numerous. They gradually increase in size and become at first yellowish and then white in the centre. As they grow, two or more frequently run together, leading to large irregular areas of dried-up tissue on the leaf. The margins of leaf often dry up in this manner and, as the dead parts crack and fall off easily, the leaflets become ragged along the edges. Around each spot is a dark brown line, outside which is a ring of pale, green or yellow tissue where the healthy part of the leaf is being invaded by the fungus. The chief differences between the root disease and this are that in the former a large part of the leaf turns pale and then yellow, without the formation of definite white spots. The ends of the leaflets droop and wither but turn brown instead of white at the tips and edges, and do not become ragged. The central shoot is stunted and eventually withers from above downwards, whereas in the leaf disease the central shoot is little affected except in bad cases. A few spots of leaf disease are common on coconuts all along the Malabar coast. In young gardens it may become a serious blight, as young palms are more affected than old. In one garden, where the palms were about seven years old, the appearance from a distance resembled that produced by root disease, but closer examination showed no trace of the latter. There was no drooping of the leaf ends ; all the leaves were dotted with white spots surrounded by a yellow ring, so close together that the leaves looked quite yellow from a little distance. Severe outbreaks of this disease have been reported from Java and elsewhere. They have only occurred on young trees and except in the latter the fungus does not appear to do much harm. It is worst in Travancore on neglected young palms and in the garden referred to above an application of manure had resulted in a marked improvement. Cultivation and manuring appear to be all that are required in most cases for its checking.

(2) Bud rot caused by Pythium Palmivorum.—At Changanachery a few cases of this disease in coconuts were seen. It is the cause of the Gódávari palmyra palm disease and in the latter district, attacks coconut and areca palms also though less severely. A general description of the Gódávari disease has been published in the Agricultural Journal of India, Volume I., Part 4, October 1906, and a technical account of the parasite in the memories of the Department of Agriculture in India, Volume I., No. 5, February 1907. The withering of the central shoot at an early stage of the disease is the most characteristic feature and serves to distinguish it from root disease, in which the central shoot is only affected at a later period. The first external symptom is the turning white of an entire leaf, usually towards the centre of the crown. This is rapidly followed by a similar discolouration of the central shoot or unopened leaf that stands up in the centre of the crown. After a short time the central shoot rots and eventually the whole crown falls off. This is accompanied by an extreme degree of putrefaction, the whole "cabbage" becoming converted inside into a foul-smelling, putrid mass. The palm may be killed in a few months, so that the attack is much more virulent than in root disease. Recovery is very rare. On the young unopened leaf blades and the white leaf bases in the "cabbage," brown spots with a distinct margin will be found. These are covered with a white felt of fungus threads. In Changanachery, *Pythium palmivorum* was found producing its characteristic spores on young leaf blades in the unexpanded stage of the bud. The "cabbage" was so rotted that only small fragments of it could be found elsewhere than on the blades. The affected trees were doomed as the apical growing point was affected.

There is no remedy once the centre of the crown is reached. To save neighbouring palms from infection, it is necessary to cut off and burn the diseased crown as soon as one or more internal leaves are observed to have withered.

This should be done promptly as the disease is highly infectious and is a very dangerouos one.

(3) Insect Attacks.—The two well-known large insects which attack coconut palms, the black beetle or rhinoceros beetle and the red beetle or palm weevil, are common in Travancore. Only the latter's attacks are liable to be mistaken for root disease and that only exceptionally. In a few cases the weevil attacks the cabbage in such a manner as to cause several of the central leaves to turn yellow. These, however, dry up simply because they have been partly eaten through at the base, and consequently they can be easily pulled out, when the cause of the injury will be evident. Most palm climbers will tell at once by examining an affected crown whether it is due to weevil or not, as all are familiar with the white fat grub an inch or two long and with the damage it causes. The black or rhinoceros beetle is common on diseased as well as healthy palms and its effects may be easily recognised by the ragged appearance of the leaves of attacked trees. These are often partly eaten through while still folded within the bud and, after expanding, a symmetrical portion of the leaf or of a few leaflets is found to have been bitten off.

A scale insect occurs on the leaves in some localities, and produces a yellowing which might be mistaken on a superficial examination for root disease. It is easily recognised on turning over the leaf, when numerous colonies of a small brown insect closely fastened to the under surface of the leaf will be found.

E. J. Butler, Imperial Mycologist.

20th December, 1907.

[The above report of the Imperial Mycologist has reached us. It is a lengthy document, but as we find on perusal that in addition to the description of the disease, it contains much valuable practical advice regarding the cultivation of the coconut palm and is altogether a most instructive and important document, we have decided to print it in full. The chief recommendation made by Dr. Butler as regards British territory is that the import of living plants from Travancore and of any portion of the roots and underground stem should be prohibited. Hon. Mr. J. N. Atkinson, c.s.i., is, we note, on behalf of the Agricultural Branch of the Madras Revenue Department, asking Dr. Butler to prepare a brief note descriptive of the disease suitable for translation into Malayalam and wide circulation among all village officers, leading agriculturists, and agricultural associations, and for publication in the local vernacular press. The Secretary of the Agricultural Society here might endeavour to get a copy of this in English in order that if the disease appears in Ceylon it could at once be issued broadcast in the vernacular.—Ed.]

The Report of Dr. Butler, Imperial Mycologist, on the coconut palm disease in Travancore, discloses a situation that gives considerable cause for alarm. Though unable to ascertain the total area affected, the trouble, in Dr. Butler's opinion, is confined to North Travancore, and the extent of the damage already caused may perhaps be gauged, he thinks, by the fact that, in spite of the rise in prices in recent years, the trade in coconut produce accounted only for 32 per cent. of the entire exports from the Travancore State in 1905-06, against an average for decades past of nearly 50 per cent. Besides the coconut, other palms, such as the talipot, sago and areca, are also affected, especially the last mentioned. The chief danger lies in the fact that the disease is undoubtedly infectious, and there appears to be no reason why, if neglected, it should not eventually spread all along the Malabar Coast. The intensity of the disease differs in different localities. In the submontane area around Minachil death is a frequent termination. In Alleppey and Changanachery deaths are rare. In the former, the attack first began in areca palms and subsequently extended to coconuts. It spread most rapidly and it still most severe in the low-lying, badly-drained lands along the valley of the Minachil River. Gradually the hill-side gardens were attacked, until at the present time scarcely a garden between Erattupetta and Pulliyanure is free from the disease. In areca palms it runs its course more rapidly than in other species. In one garden visited, only thirty areca palms had survived out of six hundred. Death has been known to occur in three years

from the first attack, but the usual period is five or six years. In coconuts, young palms may be killed in five years, but this is exceptional. Eight or ten years appears to be a more usual period, while in very many cases the disease progresses enough to cause barrenness, but fails to kill the tree outright.

As regards the identity of the disease, all that can be safely said at present, Dr Butler states, is that the roots of the diseased palms are rotted by the attacks of a parasitic fungus which appears to be a *Botryodpilodia*, and that the root rot caused by the latter is probably the cause of the present trouble. As a general rule, the first indication that a coconut palm is attacked is the opening out of the outer leaves from the head. Eventually the leading or central shoot becomes stunted and pallid, any may dry up altogether. The nuts become affected being fewer and smaller than usual ; the white kernel is shrivelled, and the copra prepared from it is said to be deficient in oil. Dr. Butler adds :—"The fluid inside is reduced in quantity (or even I was told sometimes absent, though I did not see any such case) and is altered in quality, becoming unpalatable to drink. In later stages a large proportion of the nuts drop in an immature condition. In more severe cases the spathes are unable to burst out at all or if they do, rot away early and the palm becomes barren. In healthy palms a bunch of nuts is given about every two months. The best trees in the submontane districts yield about sixty to eighty nuts a year. Nearer the coast the yield may rise to eighty or hundred, though the average is much lower. I was shown one fine palm that gave up to a year or two ago, an average of twenty nuts per bunch ; it is now diseased and gave this year only three or four."

The coconut disease which has lately been attracting so much attention in Ceylon, where it is called the bleeding stem disease, though similar in many respects to the Travancore disease, is nevertheless different, being attributed by Mr T Petch, the Ceylon Government Mycologist, to a fungus known as *Thielaviopsis Ethaceticus*, which in India, Dr Butler says, as far as is at present known, is perfectly harmless. The Godavery palm disease is different again, being attributed to a fungus called *Pythium palmivorum*. The most characteristic feature of the latter is the withering of the central shoot in its early stages, whereas in the Travancore disease the central shoot is only affected at a later period. Dr Butler considers the Travancore disease so serious that he recommends that the export from Travancore of living plants and of roots (said to be used for fuel by metal workers and also as medicine) should be forbidden. The danger is specially great to the neighbouring State of Cochin, between which and Travancore there is a very large waterborne trade in coconut produce A large number of coconuts are grown in Cochin and that State adjoins on the north the extensive coconut districts of British Malabar ; so Dr Butler suggests, and with good reason, that stringent regulations are required to prevent the infection of those areas. The British Districts of Coimbatore on the north-east and Tinnevelly on the east have less to fear, the trade between them and Travancore being less extensive and probably including little export of raw coconut produce ; and no danger is to be apprehended from the nuts, coir, oil and the above ground parts of the coconut tree.

THE "GRAPE FRUIT" AND THE POMELO.

Croydon, March 20th.

Sir,—In your issue of 26th February I read that Mr C Drieberg, Secretary of the Agricultural Society, has just received from the United States Department of Agriculture, Washington, packets of seeds of the grape fruit of Florida. The paragraph goes on to state that the identity of the grape fruit has not been properly settled. It is stated to be the permelo (*citrus decumana*) the Jambola of the Sinhalese ; and again it is said to be a cross between the sweet orange (*citrus aurantium*) and the permelo and produced in clusters like the grape. The United States Department of Agriculture calls it the permelo. But these points could be settled when the seeds now put down produce fruit after a number of years.

Now the above rather surprises me. When in 1896 I copied into the *Ceylon Observer* from a horticultural journal a statement that the "grape fruit" was identical with the pomelo, the authorities at Kew waxed furious, and you wrote that an apology was due to them by the *C.O.* for inserting such a statement. And yet now I see that the United States Department of Agriculture call the "grape fruit" the "permelo' [*sic*]! As I wrote to you recently, quantites of "grape fruit" from Jamaica were selling on barrows in London at two a penny, and delicious they were: at the same time, I do not think they excel a really good Ceylon pomelo.

As regards the spelling "permelo" : is this an Americanism ? I never saw it before, though I have seen *pomelo*, *pometoe*, *pumelo*, *pummelo*, *pumelow*, &c., &c.; while to go back to the original (?) *dompelomes*, we have amongst other strange corruptions *pimplenose*, and *pumpel-nut* ! (the latter in the English translation of Wolf's account of Ceylon.)

Whatever the origin of the absurd and misleading name "grape fruit," the sooner it is dropped the better. It is almost as bad as "grape nuts," which have not the remotest connection with either grapes or nuts.

DONALD FERGUSON.

THE "POMELO OR PUMMELO"

Sir,—I see Bonavia in his "Oranges and Lemons of India and Ceylon" has the following :—"The word pummelo is, of course, a corruption of the Dutch Pompel-moes, through Pummelnose, by first making it Pummelos, and then turning it into the singular *Pummelo*." He adds :—"Shaddock is said to come from Capt. Shaddock, who first introduced it into the West Indies."—Yours, &c.,

HORTICULTURIST.